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EDITORIAL ANNOUNCEMENTS.

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Railway Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

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VOL. XLI., No. 20. FRIDAY, NOVEMBER 16, 1906.

The butting collision near Woodville, Indiana, last Monday morning, makes the fifth great railroad disaster since July 1; Salisbury and Grantham, England; Hamlet (N. C.), Atlantic City and Woodville, in America. Such a list, showing 157 persons killed and 111 injured, recalls the fact that the accident record for one year (or even for a much longer period) may show moderate losses of life and property, and yet afford no certain gage of progress or improvement in safety of railroad travel. It emphasizes the need of having a strictly scientific basis for all our efforts toward greater security against collisions and derailments. Another thing to keep in mind in case of such a collision as the most recent of this list, or that at Hamlet, is that the cause is not exceptional. Such an accident, of sufficient magnitude to attract general attention, may occur once in a year, perhaps; but others of the same kind occur every month. The last quarterly Government accident bulletin shows eight prominent collisions (not to mention the less costly ones) which were due to mistakes concerning orders or meeting points. We say this to refresh the memories of editors who seem to have forgotten it, and for the benefit of railroad officers who surely cannot have forgotten it, but whose action indicates to the public that they have. As to the details of the cause of the Woodville collision we are not fully informed, and the question is not important. The accounts indicate that the engineman of the freight misréad a despatcher's order; or had received an incorrect order; or had failed to observe green signals on the engine of a preceding westbound passenger train; or had been deceived by absence of such signals on that train. All of these errors or faults occur frequently, and the fact that all efforts to prevent or cure them, except by the use of the block system, have been unsatisfactory, is known to everybody who takes the trouble to look into the matter.

The comparison of cost of steam locomotive and electric power which is the subject of a contribution printed in another column is interesting but it is not conclusive. From an involved calculation of train resistance and coal consumption the writer estimates the coal consumption of a steam locomotive at from 9 to 15 lbs. per effective horse-power per hour, and compares this with an estimated consumption of 3 lbs. per horse-power hour under electric operation. The locomotive tests made at St. Louis in 1904 and confirmed by other tests showed that the coal consumption of steam locomotives, simple and compound, freight and passenger, is from 2 to 5 lbs. per dynamometer horse-power per hour; these tests were made under all conditions of load and speed. Making all proper allowances for the superior conditions of the locomotives under test, intelligent firing, continuous operation and the great waste of coal in road service, a difference of more than 300 per cent. between the estimated and test results cannot be entirely accounted for. The principal error in the writer's estimate is in neglecting the important factor of the number of trains run and in calculating train resistance by weight alone. Had a similar estimate been made of some electric road already in operation the coal consumption per horse-power hour would have been much greater than 3 lbs. Comparisons, for whatever purpose, must be on the same basis to be of value.

Last week in these columns we pointed out the high efficiency of the locomotive as a steam power plant, an efficiency in point of steam consumption which compares favorably with most stationary plants operating under similarly wide variations of load. Locomotive designers are concerned only with improving the details to make the machine as a whole even more efficient, that is, to use all of its power in hauling trains with maximum economy. If the figure of coal consumption estimated by our correspondent, assuming it for the moment to be correct, could be divided into two parts, the coal consumed in useful work and the coal wasted, locomotive designers would disregard the second part and ponder only over the first. Without such a division, results obtained by accurate tests only can be used, and it is obviously unfair to charge up to the steam locomotive, fuel wasted by improperly handling it or by working it above or below its economical load. As much energy can be wasted by an electric locomotive as a steam locomotive. Our correspondent's arguments have not changed the position taken by the *Railroad Gazette* since the beginning of the discussion of electrified steam roads, which is best expressed by Mr. Aspinall, General Manager of the Lancashire & Yorkshire: "We did not enter into electric traction . . . to save money; we expected to make money."

The experiment of charging 50 cents a day for use of interchanged freight cars is now to be tried on a large scale. While cars are in a great majority of cases worth at the present time much more than 50 cents a day, the adoption of this rate at last week's

meeting in Chicago is a radical step. The rate now is 25 cents; four months ago it was 20 cents, and four years ago it averaged about 12 or 13 cents. It must always be remembered in dealing with this problem that, whatever the rate, it is attempting the impossible to make a uniform rate serve satisfactorily in exceedingly diverse conditions. To those acquainted with car service, the action taken will serve as one vivid indication of the recent great increase in volume of freight. Desperate diseases demand desperate remedies, and the unanimity among so many prominent railroads of the country in this matter indicates their tremendous need of cars. It is said that large roads owning 300,000 cars will refuse to join in this temporary arrangement, believing it to their interest to take no action until it can be taken through the regular machinery of the American Railway Association, which means retention of the present rate until next July. To thus have two rates in use everywhere will be a clerical annoyance, but not necessarily anything more serious. The philosophical spirit which cheerfully submits to losses and injustice is necessary to the success of any car interchange agreement, and it would be rash to predict that the necessary amount of this spirit will not be found. Nobody believes that unprincipled borrowers will be made honorable by doubling the cost of their borrowed cars, for if the rate were quadrupled it would still be cheap, compared with the profit to be made from use of the cars under present traffic conditions. The imposition on the car owner will, however, be materially lightened, and superintendents will have an intensified argument to use in getting cars moved and in stirring up consignees. This will cure a multitude of lesser evils, even if not the greater ones. The Chicago meeting did not do anything toward curing the diversion difficulty, but it did what was better, referred it to a competent committee of three—as strong a committee as could have been found. An agreement to penalize diversion has thus far failed because of its perplexities. It is the most troublesome part of a wholly troublesome business, and all eyes will be turned toward this committee for a plan of solution which can be generally agreed on.

HEAVY LOCOMOTIVES AND THE RAILROADS OF THE FUTURE.

Breaking records in building heavy locomotives has recently become almost a mania. For more than two years the Mallet compound of the Baltimore & Ohio was the undisputed giant, but it was displaced by the locomotives of the same type for the Great Northern built last summer. These in turn give way to the Erie compounds to be turned out next spring. Almost simultaneously with the announcement of the contract for building the Erie locomotives comes the news that the Pennsylvania has designed a new class of consolidation freight locomotives which will be heavier by 20,000 lbs. than any other engines on that road of heavy motive power. The heaviest Prairie type locomotive yet built was delivered to the Atchison, Topeka & Santa Fe a few weeks ago.

This trend toward extra heavy locomotives is not the result of competition by the builders to hold the record for heavy engines. They would prefer to turn out smaller locomotives and more of them, for their shops are not as well adapted to the heavier work. The railroads are making the demands; the builders are simply carrying out the wishes of their customers. Nor is the demand from the railroads confined to a few or to any section of the country. Operating officers everywhere are trying to move the enormous amounts of freight offered and keep down the cost of transportation to the lowest limit. Locomotives and men are being overworked and the one solution seems to be bigger locomotives and bigger train loads. The saving in time and in wages by doubling the number of cars in a train is a strong incentive for using the heavier power. The economy of heavy train loads in most cases cannot be questioned; the results of the steady increase in train loading of the last ten years are convincing enough. Similar economies in reduced increments may reasonably be expected with further increases, and on that point there is justification for the extremists who advocate such radical advances in locomotive design and train operation.

What is going to be the result in other ways of using the heaviest types of locomotives now being turned out? Not a single railroad in the country has shops or roundhouses big enough to hold them. They cannot be turned on any turntable in existence. Many, if not most, of the bridges are overloaded when they run over them—perhaps not to an immediately dangerous point, but certainly beyond the assumed loads for which they were designed. When they exert their maximum power, the cars and draft attachments in the train are strained to the breaking point. In case of a wreck or derailment no wrecking equipment could put them on the track or clear them off the track possibly for days after the accident. The present track structure was not designed for carrying such loads; it is with difficulty that it can be made to stand up under much less severe conditions. Yards and terminal facilities are inadequate to care for the trains these heavy engines can and should haul.

These are some of the serious objections to the use of the biggest locomotives that exist to-day. How long will these conditions continue to exist as valid grounds for objection? If locomotives of great power such as the Erie has ordered, are to come into general use, enormous sums must be spent to bring up the other parts of the complicated machinery of transportation to the same standard. Like the heavy expenditures involved in electrification, which are not for electric equipment, but for other improvements which must be made along with the change, the cost of the improvements which will make possible economical operation of heavy locomotives must be charged against the saving in operating expense by their use.

It would be interesting, if it were possible, to plot the curve of saving in operating expenses due solely to the use of locomotives of increasing power and against it the cost of new engine terminals, track, bridges, yards and cars. The intersection of two such curves would show the point of maximum efficiency for the whole machine, which is what all the railroads are striving after. Has the motive power department in response to demands from the operating department overshot the mark and gone beyond the economical limit of size? Six or eight years ago this same question in a different form was asked on all sides when the 50-ton car was first introduced. It was possible to build such cars, but the question was, how about the wheels and the draft gear and the old light cars coupled in the same train? Where were 50-ton loads coming from on every trip? But who will say that their general introduction has not effected striking economies in operation? The points about which there was doubt straightened themselves out in time.

So with these heavy locomotives. They are a radical step in advance, and distancing the steady if somewhat slow progress in other departments. It is now the turn of the other fellow. If the track proves too weak it must be strengthened; the yards must be enlarged; adequate engine terminal facilities must be provided and every detail correspondingly improved. An apparent extreme of this kind now and then perhaps is a good thing; it makes for progress in all directions and forces others out of their self-satisfaction to show what they can do if they have to.

THE FINANCES OF A GREAT TERMINAL.

The South Station at Boston, opened Jan. 1, 1899, and occupied and operated by the Boston & Albany and the New York, New Haven & Hartford, stands in the front rank of the great passenger terminals of the world and will long continue to hold one of the foremost places. The main station is 850 ft. long by 725 ft. broad and covers some 13 acres, with a train shed 602 ft. long and 570 ft. wide. The whole terminal property contains 35 acres with 15 miles of track, 4 miles of it under roof, and a total car capacity of 613 cars, 252 cars under roof. Besides loop tracks in its subway, the station has 28 regular tracks used each year by some 25,000,000 passengers. The daily train movements in and out of the station are indicated by the following table:

	Week-day Trains.		Sunday Trains.	
Boston & Albany		217		79
New York, New Haven & Hartford:				
Providence division	281		99	
Plymouth division	223		66	
Midland division	80		28	
		593		193
Total regular trains		810		272
Storage yard drafts		420		120
Light engine movements		370		180
Grand total daily movements to and from station		1,600		572

At a time when great terminal passenger stations in the large cities of the country are so costly yet imperative ventures of our prominent railroad companies; when the big terminal has, in fact, become a logical product of railroad maturity, it is of interest to know concrete facts in the fiscal operation of the South Station at Boston. Very few, if any, of the figures for the terminal have, we believe, ever before been published.

The returns for the fiscal year ended June 30 last, of the Boston

Terminal Company, through which the two proprietary railroads built and financed the South Station, give total revenue from the terminal for the year of $321,324. The more important entries follow, together with comparisons for the year preceding:

	1906	1905
Parcel room	$27,495	$24,837
Baggage storage	10,568	9,938
Pay lavatories	7,729	7,123
Power, heat, light	12,219	12,077
Pintsch gas	99,981	96,221
Ice	8,156	10,282
Rental, offices and buildings	60,734	60,795
Rental, restaurant	14,800	13,999
Other concessions	67,025	62,768
Revenue, Atlantic Ave. Ext. bridge	12,562	158

The total revenue for the terminal for the year 1905 was $299,191, which is $22,000 less than in 1906, or $10,000 less if we exclude the bridge revenue in the more recent year. The tendency toward increased revenue from practically all of the station concessions will be noticed as a suggestive feature.

Taking up next the terminal expenses, they appear under three heads: Maintenance of buildings and tracks, operation, and general expenses. Under the first head, which covers repairs merely, the prominent entries for the two years follow:

	1906	1905
Surface tracks	$32,300	$31,292
Subway and tracks	683	1,034
Interlocking	18,474	15,222
Station building	10,364	9,912
Train shed	5,338	8,136
Power house	15,283	13,969
Gas plant	12,914	14,429
Ice plant	1,083	1,176

The total for 1906 was $97,288, as compared with $99,747 in the previous year, indicating that this branch of expense remains about stationary in spite fo some increase of terminal business.

Under the much more important head of "Operation" the following entries appear:

	1906	1905
Superintendence and service	$50,590	$52,148
Ticket and baggage agents	106,024	104,419
Cleaning station	10,023	9,839
Station expense	15,847	15,685
Power house	56,700	60,718
Gas plant	28,717	29,355
Interlocking	25,021	25,030
Loss and damage	287	9,841
Personal injuries	11,288	8,902
Ice plant	6,788	7,597

The total outlay for operation in 1906 was $311,289, as compared with $323,540 in 1905. These returns become respectively $299,719 and $304,797, if we exclude the obviously variable return for loss, damage and personal injuries, suggesting a slight tendency, perhaps temporary, toward decreased operating expense. The general expense entries follow in full:

	1906	1905
Salaries of general officers	$14,921	$16,868
General office expenses	2,080	1,464
Insurance	350	387
Legal expense	1,643	1,104
Stationery and printing	3,008	2,596
Total	$22,002	$22,419

The summaries are:

	1906	1905
Maintenance of tracks and buildings	$97,288	$99,747
Operating expenses	311,289	323,540
General expense	22,002	22,419
Total	$430,579	$445,706
Less revenue	321,324	299,191
Expense over revenue	$109,255	$146,515

The Boston Terminal Company is capitalized at $500,000 of stock owned by the two proprietary railroad corporations—mere "holding" capital—and $14,000,000 3½ per cent. bonds. The charter of the company provides that in case of foreclosure, any deficiency shall be made up by the subscribers to the stock of the company, the lessees, which are the Boston & Albany, the New York, New Haven & Hartford as lessee of the Old Colony Railroad, the Old Colony, the Boston & Providence Railroad Corporation and the New England Railroad. This charter provision is, of course, equivalent to a guarantee of principal but not of interest on the bonds. To the deficit of $109,255 in the income account of the last fiscal year is to be added $490,000 fixed charge for interest on bonds and $8,625 taxes, raising the total charge above revenue for the year to $607,880, of which 25 per cent. ($151,969) was paid by the Boston & Albany and 75 per cent. ($455,911) by the New York, New Haven & Hartford. In the balance sheet of the Terminal Company, construction is entered under date of Aug. 31, 1906, at $15,015,628, and total payments by the two companies on account of expenses up to the same date $4,490,678, of which the Boston & Albany has paid $1,122,669 and the New York, New Haven & Hartford $3,368,008, or about $600,000 a year net loss on the terminal investment by the two roads, a little less than 4 per cent. on the cost of construction. At the present time bonds in the nature of those of the Boston Terminal Company could hardly be marketed on a much lower interest rate basis than 4 per cent., adding say $70,000 to the annual fixed charge; while, with the great rise in cost of material and labor during the last seven years, to cover the cost of construction several millions more bonds would be required, with corresponding fixed charge additions.

The realistic case of the South Station at Boston with its actual returns for operating cost and charges confirms, as a mere matter of figures and book-keeping, the common opinion and is to the long-delayed return in dollars and cents on the vast investments in great railroad terminals. But the reasoning must not stop there. In this very example must be reckoned in the great though indeterminate factors which are in the nature of credits against the bookkeeping debits. Some of them are general, some specific and localized to Boston. Setting them forth interrogatively: What was the annual loss at which the two companies were running their former separate stations? What credits are to be entered for the value as real estate of the stations discontinued? How much larger would have been the losses had the companies been forced each to build a new station? What traffic gains have been scored by having one great station convenient for the public, especially in Boston's immense suburban business, and what vantages secured, or losses reduced, as against the acute rivalry of the street railways? What are the future possibilities of electric operation in the station subway, which was expressly designed for such a service? And, finally, does not the joint station stand in a more or less pacifying relation to the rivalry of the two proprietary lines in New York-Boston passenger traffic? But even if all such questions could be answered negatively the inexorable demand of public necessity and convenience in our great cities remains, to which the big passenger terminal is the necessary and only response.

St. Louis & San Francisco.

After a period of rapid expansion the St. Louis & San Francisco this year shows an increase of only 38 miles in operated mileage. Its railroad lines, as shown in the map published at the time the annual report of the Chicago, Rock Island & Pacific was reviewed in these columns some weeks ago, center about the area bounded by Kansas City and St. Louis on the north, Central Kansas and the Panhandle of Texas on the west, the Red River on the south and the Mississippi River on the east. Some of its through lines overstep these boundaries; for instance, the Birmingham, Ala., line and the line from Denison through Ft. Worth to Brady, Texas. Along with the Rock Island its influence is just being extended southward through the new line of the Trinity & Brazos Valley, which is being opened to Houston and Galveston, and is to be extended farther by the Colorado Southern, New Orleans & Pacific, when it shall be built from Houston east to Baton Rouge and New Orleans. It also owns, as a northern connection, the Chicago & Eastern Illinois, bringing it from Thebes and St. Louis through the coal fields of Illinois to Chicago. The Evansville & Terre Haute and Evansville & Indianapolis, also controlled, tap the coal fields of western Indiana.

The problem of the St. Louis & San Francisco proper is to develop a profitable business on a large mileage of new lines in the new Southwest. Gross earnings in the past year were $32,000,000 against $30,000,000 in 1905, a gain of 7 per cent. Net earnings increased $11,500,000, or 8 per cent. The net income over all charges was equal to 4 per cent. each on first and second preferred stock and 5 per cent. on the $29,000,000 common stock, but following the present policy of the Rock Island group, instead of paying the full 4 per cent. on the two preferred stocks as in 1905, only 2 per cent. was paid on the $16,000,000 second preferred stock. The money is to be used instead in the improvement of the road. No dividends have ever been paid on the common stock.

There was an increase of $457,000 in the cost of maintenance of way which rose from $714 per mile in 1905 to $799 per mile. More than half of the increase was in the one item, repairs of roadway. Repairs and renewals of locomotives increased by $200,000, and maintenance of equipment, as a whole, by $272,000. The unit maintenance charges for equipment including renewals were $2,313 per locomotive against $2,142 in 1905, $780 per passenger car against $698 in 1905, and $50 per freight car against $50 in 1905.

The weakest point of operation of the road has been the large proportion which conducting transportation bears to gross earnings and total operating expenses. This was but little bettered during the past year. As against 57.9 per cent. in 1905, conducting transportation was a little more than 57.1 per cent. of the total operating expenses. Of the gross earnings 36.6 per cent. was paid on conducting transportation account against 37.4 per cent. in 1905.

There was an increase of 306,000,000 in the number of revenue ton miles and a decrease of 14,000,000 in the number of passengers

carried one mile. The train load is low, 214 tons last year as against 200 tons the year before and only 28 tons higher including company freight. If the extension to the Gulf results in any large amount of through traffic this figure will undoubtedly be increased. Commodity statistics are given showing increases and decreases both in tons and per cent. The general traffic of the road is being built up in almost all directions; the tonnage of agricultural products increased 12 per cent.; of animal products, 9 per cent.; of manufactures, 18 per cent.; of lumber, 14 per cent., and of miscellaneous commodities and merchandise, 15 per cent. Tonnage of mine products remained nearly stationary. In proportion to the whole, however, it fell from 42 to 39 per cent.

A 6½-mile extension of the Winkler branch in Phelps County, Mo., to iron ore deposits was finished August 1, 1906. Jointly with the Chicago, Rock Island & Pacific a large new freight terminal is being built in North St. Louis. This is being done by the Rock Island-Frisco Terminal Company, which is to operate the property. There has already been spent by the St. Louis & San Francisco $712,000 on this account. The new terminals have lately been put in operation. There have been 361 new manufacturing plants located on the lines during the year whose estimated cost is $9,000,000, and which will employ about 10,000 men.

The principal results of the last two years' operation are as follows:

	1906.	1905.
Mileage worked	5,069	5,030
Freight earnings	$21,955,975	$20,111,455
Passenger earnings	7,908,644	7,647,578
Gross earnings	32,046,657	29,958,240
Maint. way and structures	4,049,094	3,592,174
Maint. of equipment	3,803,211	3,530,357
Conducting transportation	11,742,742	11,163,560
Operating expenses	20,545,533	19,297,017
Net earnings	11,501,123	10,661,223
Net income	2,309,136	1,024,128
Dividends	519,742	839,742
Year's surplus	1,789,394	184,386

Great Northern.

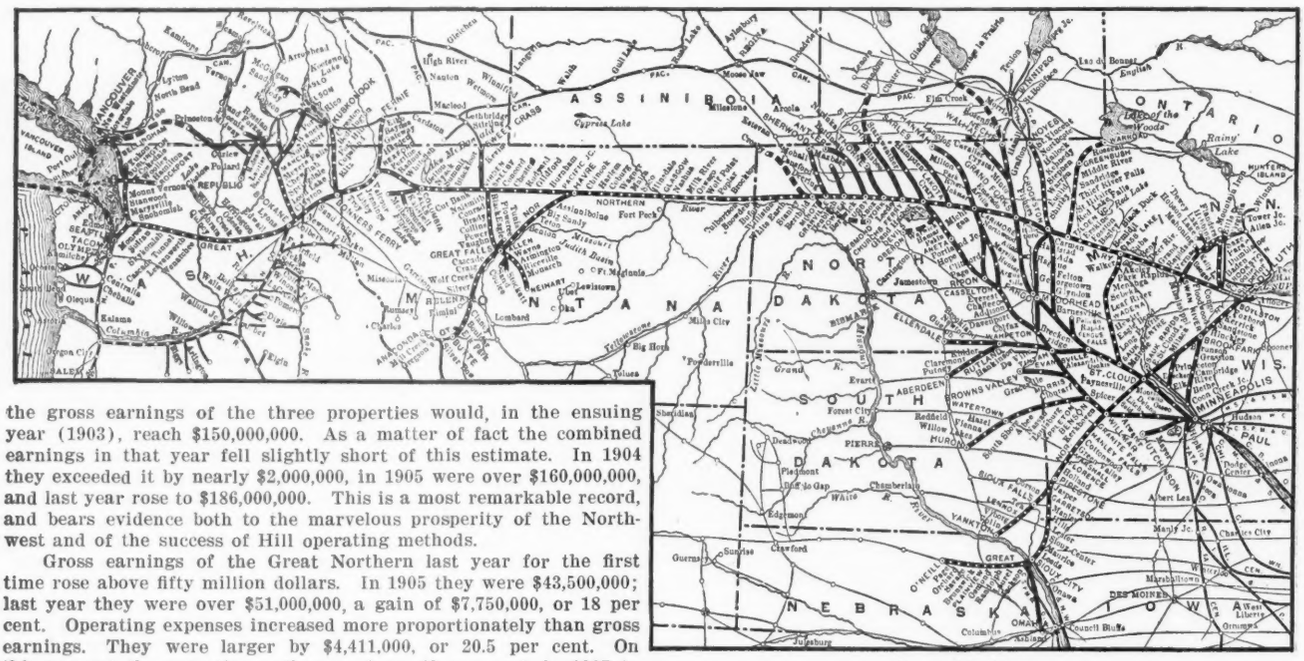
In reviewing the third, in many ways the most important, and certainly the most typical of the Hill railroads (the annual reports of the Northern Pacific and the Burlington, having been reviewed in previous weeks), it is worth while to call attention, as was done a year ago, to Mr. Hill's reported prophecy made in 1902, that the gross earnings of the three properties would, in the ensuing year (1903), reach $150,000,000. As a matter of fact the combined earnings in that year fell slightly short of this estimate. In 1904 they exceeded it by nearly $2,000,000, in 1905 were over $160,000,000, and last year rose to $186,000,000. This is a most remarkable record, and bears evidence both to the marvelous prosperity of the Northwest and of the success of Hill operating methods.

Gross earnings of the Great Northern last year for the first time rose above fifty million dollars. In 1905 they were $43,500,000; last year they were over $51,000,000, a gain of $7,750,000, or 18 per cent. Operating expenses increased more proportionately than gross earnings. They were larger by $4,411,000, or 20.5 per cent. On this account the operating ratio rose from 49 per cent. in 1905 to 50 per cent. last year. The Great Northern operating ratio has long been the marvel and the despair of other roads. It is never possible to analyze it at all carefully, because no detailed tables of operating expenses are given in the reports, a policy which has also been in force on the Northern Pacific and the Burlington since they have been Hill roads. It is, therefore, possible to work out only one of the unit maintenance figures, that for maintenance of way per mile. This was $973 in 1905 and $1,092 in 1906, an increase of $119, or 12 per cent. per mile. This seems by no means a large figure for a road whose revenue traffic density is 784,345 tons one mile per mile of road, although it must be remembered that the Great Northern has a large branch line mileage, occupation of its territory by feeders of the main stem being its characteristic form of development.

The clearest hint of the operating methods which are used to keep down expenses in proportion to earnings, is found in the average train load. This was 530 tons of revenue freight last year, a truly remarkable figure for a transcontinental line with a large amount of branch line agricultural territory. It was the Great Northern, of course, which set the example to all the other railroads of the country of scientific train loading, particularly by means of locomotive rating. The Hill policy has always been to wait for a load before sending out a train. This has been possible because so large a proportion of its traffic has been bulk grain and, on the lines at the head of Lake Superior, ore. The increase of last year's train load over the 1905 figure is small, but in the last two years there has been a total increase of 82 tons. The average number of cars in a train is 37, with 20 tons of revenue freight in each car. Thus strictly operating results are in great measure responsible for the low operating ratio of the road.

The showing of the past year in earnings is, of course, a remarkable one. It was pointed out in the review of the previous year's report that as both gross and net earnings were smaller in the year 1904 than in the year immediately preceding, all comparisons were uncommonly favorable for 1905. It is suggestive of the way new high records are now being made by railroad companies to observe that this uncommonly favorable comparison showed an increase of $3,500,000 in gross and $2,600,000 in net earnings for 1905. These look small in comparison with the gain of $7,750,000 in gross and $3,400,000 in net last year. Considering the freight traffic, the fact that the number of tons of revenue freight hauled one mile increased 896,386,043 units during the year, following an increase of 813,358,569 units during 1905, is evidence of a remarkable gain. Here in the last two years is, not a total ton mileage, but an *increase* of over one billion and a half ton-miles. Freight earnings increased $6,000,000, or 18 per cent. Passenger train earnings increased $1,688,000, or 17 per cent. The gain in passenger earnings can be, to some extent, attributed to the Portland Exposition.

The increase of $4,411,000 in operating expenses came more than half in conducting transportation, this increase being due directly, according to the report, to increased train service, the opening of new stations, increases in forces and the general high prices prevailing for all classes of labor and material. Conducting transportation cost increased 21 per cent. Maintenance of way increased $880,000, or 15 per cent., and maintenance of equipment a little over $1,000,000, or 27 per cent.



Great Northern.

The latest official map of the road, published herewith, shows such part of Mr. Hill's projects, north of the Canadian boundary, as have been officially announced. Of the two lines reaching north into Manitoba, the more eastern from a connection with a Great Northern branch on the International boundary at Neche, N. Dak., to Portage la Prairie, Man., 77 miles, is being built by the Midland Railway of Manitoba, and is about finished. The other line is similarly an extension northward of a Great Northern branch in North Dakota. This runs from St. John, N. Dak., to Brandon, Man., 70 miles, and is also about ready to be put in operation. It is being built by the Brandon, Saskatchewan & Hudson's Bay. A large

amount of branch line construction is under way in the United States, particularly in North Dakota. A 59-mile line, which is being built to connect a branch line from Aneta, N. Dak., to Devils Lake, is to form a short main line between St. John and the west, helping to relieve traffic congestion between Devil's Lake and Grand Forks. An important line is being built from Armington, Mont., south to Laurel, 200 miles. This is to form a connection between the Great Northern and the Montana Central roads on the north and the Northern Pacific and the Burlington on the south, besides opening up territory in central Montana. It will furnish the long desired direct connection between the Burlington and the Great Northern, and may be taken as an evidence that the interchange of traffic in Montana has been found to be highly profitable.

The capital stock of the road, which is all preferred, was increased by $25,000,000 during the year. Most of this has already been issued, as it was offered to shareholders at a price which made it distinctly profitable to take up. Besides this general policy of giving rights, the particular reason why Great Northern stock sells at something over 300 lies in the recent consummation of the famous "ore deal" with the United States Steel Corporation, under which, beginning in 1907 with a minimum annual payment for royalty and freight of $1,237,500, the stockholders will receive increasing sums each year, which will amount to a payment of at least $16,417,500 in the year 1917. It seems probable that these profits from lands which were obtained largely in land grants will be turned over to the stockholders, not directly in dividends on their stock but indirectly through a subsidiary company. This is particularly likely in view of the provision of the new Rate Law which forbids ownership of mines by railroads after 1908.

The following table sums up the last two years' operating results:

	1906.	1905.
Mileage worked	5,906	5,723
Freight earnings	$39,044,732	$33,013,722
Passenger earnings	9,460,659	8,000,467
Gross earnings	51,276,280	43,526,088
Maint. way and structures	6,453,240	5,571,189
Maint. of equipment	4,820,650	3,749,131
Conducting transportation	12,676,737	10,463,218
Operating expenses	25,852,923	21,441,927
Net earnings	24,423,357	22,084,161

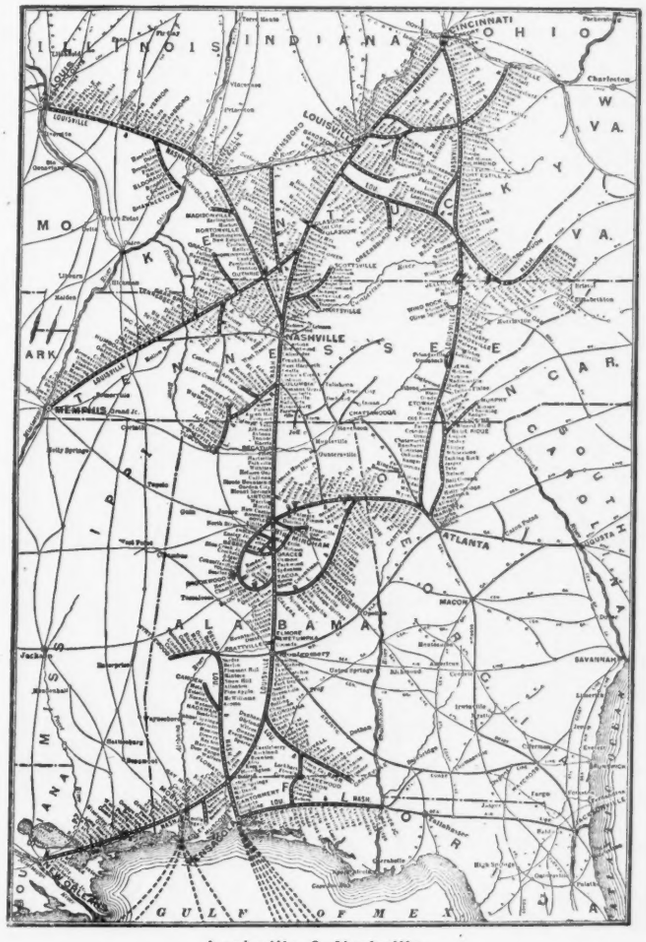
Louisville & Nashville.

The Louisville & Nashville connects St. Louis and Cincinnati on the north with Nashville, Atlanta, Birmingham, Montgomery, Pensacola, Mobile and New Orleans. It has a line to the Mississippi river at Memphis. Over the Nashville, Chattanooga & St. Louis, which it controls, it reaches Chattanooga and Atlanta. On the north, through ownership of half the controlling capital stock of the Chicago, Indianapolis & Louisville (Monon) it reaches Chicago. It is itself controlled by the Atlantic Coast Line. Included under the three heads, lines owned and operated, lines operated separately, but controlled, owned jointly or leased, and lines owned but operated by other companies, the Louisville & Nashville has 6,842 miles of line. Of this, 4,131 miles are included in the traffic figures of the report.

The company has acquired a through line from Cincinnati to Atlanta, of which the several parts are the Knoxville, Lafayette & Jellico taken over December 22, 1904, and the Atlanta, Knoxville & Northern acquired February 11, 1905. These two roads, extending from the Kentucky-Tennessee state line near Jellico, Tenn., to Marietta, Ga., together with trackage rights owned by the Atlanta, Knoxville & Northern from Marietta to Atlanta, make up the through line, all of which has been operated as part of the Louisville & Nashville system since January 1, 1905. This is being improved as a through freight route. Grades in both directions between Knoxville and Etowah, Tenn., have been reduced to 0.65 per cent. compensated for curvature, and a new line with the same ruling grades has been built between Etowah, Tenn., and Cartersville, Ga. A trackage contract has been made for running rights over the Western & Atlantic and that part of the new low-grade line between Knoxville and Atlanta opened for traffic. The reduction of grades north of Knoxville, Tenn., between Corbin and Saxton, Ky., has not yet been finished. The cost of the construction work on this new line is being financed by an issue of $50,000,000 4 per cent. Atlanta, Knoxville & Cincinnati division 50-year bonds covered by a mortgage executed April 1, 1905. This mortgage covers terminals in Cincinnati, Knoxville and Atlanta, the bridge across the Ohio river formerly known as the Newport & Cincinnati Bridge and the line of railroad from Cincinnati to Atlanta with certain branches. To June 30, 1905, there had been issued $14,543,000 of these bonds to reimburse the Louisville & Nashville; in the last fiscal year an additional $4,612,000 was issued. Of this total in its possession the company sold during the fiscal year 1906 $10,000,000, for which it received $9,750,000. The high prices at which these 4 per cent. bonds with underlying liens were sold is an evidence of the strong financial standing of the company. This is notable, in view of the fact that in 1902, when control of the road had been bought in the open market by a band of speculators, the road was turned over to the Atlantic Coast Line at a price which at that time seemed unreasonably high. It was; but the last few years have proved that it was in reality a very profitable purchase.

The characteristic feature of Louisville & Nashville policy since that time has been the expenditure of large amounts out of earnings for improvements, not in special appropriations, but directly in the operating accounts. Gross earnings last year were $43,000,000, larger by $4,500,000 than in 1905, yet net earnings were less than $50,000 larger and net income was smaller by nearly $500,000 than in the earlier year. The cause lies in the large size of the operating expenses, and is summed up by saying that although the road was amply maintained in 1905, the operating ratio increased from 68.77 per cent. in that year to 71.92 per cent. in 1906. The extent to which earnings have been turned back into the property is indicated by the fact that while gross earnings have increased from $35,500,000 in 1903 to $43,000,000 in 1906, net earnings have increased in that time by less than $600,000.

Last year this policy was carried to an even greater extreme than before. Maintenance of way and structures increased 15 per cent., maintenance of equipment 23 per cent., and conducting transportation 16 per cent. There are two items under the head of maintenance of way and structures which ordinarily are deducted from a railroad's net income. These are extraordinary expenses and improvements. In 1905 there was charged in this account for these betterments $1,574,428; last year these figures increased to $1,785,196. Similarly, under maintenance of equipment $1,202,863 in 1905 and $1,166,157 in 1906 was spent for improvements. Straight maintenance of way cost $1,150 per mile, against $1,079 in 1905; including betterments, the figures were $1,583 in 1906 and $1,490 in 1905. Maintainance of equipment cost $4,142 per locomotive, against $2,819 in 1905, an exceptionally large increase. This increase of 50.6 per cent. in locomotive repairs is due, according to the report, to heavy repairs required on the larger number of engines, including 21 old locomotives taken over with the Atlanta, Knoxville & Northern, as well as to light and heavy repairs deferred during removal from the old to the new shops at South Louisville, a period which was marked by a phenomenal increase in traffic and consequent added strain on motive power. Maintenance of passenger cars cost $1,039 per car in 1906, against $788 in 1905, and per freight car $73, against $70 in 1905. These are all exceedingly liberal figures, particularly for a road in southern territory. The increase in cost of



Louisville & Nashville.

conducting transportation is fairly evenly distributed among the different items, being particularly in those including wage payments. It is remarkable to see that it cost the road $200,000 last year for stock killed on the right of way.

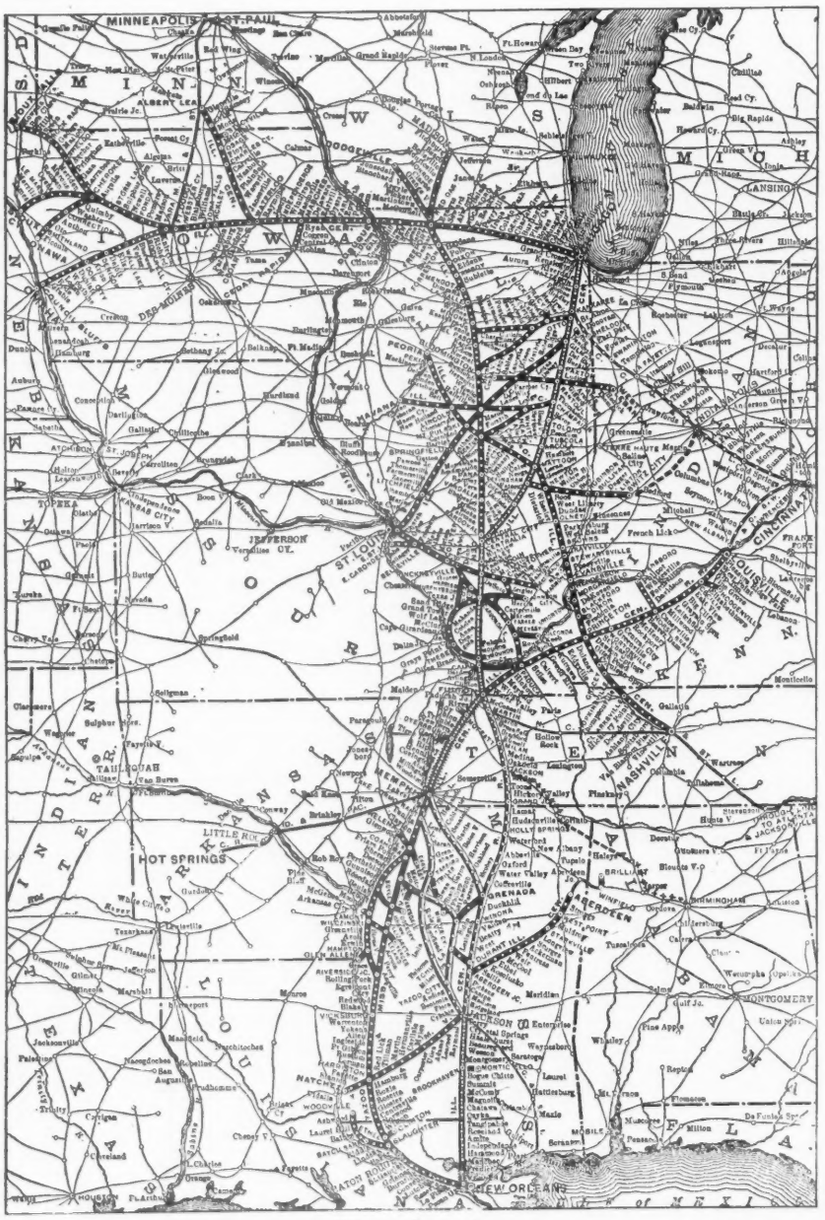
The general increase in operating expenses is given in the report as due to larger cost of labor and material, rebuilding of the Union Station at Louisville destroyed by fire, heavy repairs made on equipment in use during the St. Louis Fair, yellow fever for five months on the southern divisions and an unusual number of destructive accidents.

The Louisville & Nashville's train load is not high, being 231 tons, against 230 tons in 1905. The average revenue per ton mile was 0.803 cents, as against 0.791 cents in 1905. There was an increase of 12 per cent. in the number of miles run by revenue freight trains, a decrease of 3 per cent. in the number of loaded cars in each train, and a decrease of 10 per cent. in the number of empty cars in each train.

During the year the Chesapeake & Nashville, running from Gallatin, Tenn., to Scottsville, Ky., 36 miles, and the Middle & East Tennessee Central, extending from Hartsville Junction, Tenn., on the Louisville & Nashville to Hartsville, 11 miles, were bought for $300,000. They are now operated as part of the Louisville & Nashville system. The Henderson Bridge & Railroad Company, formerly the Henderson Bridge Company, owning the bridge across the Ohio river at Henderson, Ky., and connecting tracks to Howell, Ind., 10 miles, hitherto operated under lease, is now owned in fee; the Yellow River Railroad, running from Florala, Ala., to Crest View, Fla., 26 miles, hitherto controlled, but operated separately, was conveyed to the L. & N. on June 30, 1906.

A summary of the last two years' operations is given in the following table:

	1906.	1905.
Mileage worked	4,131	3,826
Freight earnings	$31,536,207	$27,732,625
Passenger earnings	8,985,216	8,619,650
Gross earnings	43,008,996	38,517,071
Maint. way and structures	6,537,697	5,702,533
Maint. of equipment	7,791,863	6,346,098
Conducting transportation	15,639,420	13,509,780
Operating expenses	30,933,464	26,490,021
Net earnings	12,075,533	12,027,050
Net income	6,348,375	6,827,040
Year's surplus	2,748,375	3,227,040



Illinois Central.

At this time, when the dominance of E. H. Harriman in the Illinois Central has been clearly shown, it is of especial interest to consider what sort of a railroad the new member of the Harriman group is. It is no news to readers of the *Railroad Gazette* that it is a splendid property, particularly in its financial strength. Like the Great Northern, whose report is reviewed in another column, the Illinois Central last year for the first time passed the fifty million dollar mark in earnings. Gross earnings were $51,600,000 as against $49,500,000 in 1905. Against this increase of $2,100,000, operating expenses increased a little more than half, $1,200,000, leaving net earnings larger by not quite $1,000,000, or 5 per cent. more than in 1905. The net income for the year was $10,800,000, and was large enough, following the prosperity of previous years, to decide the management to begin the payment of 7 per cent. as a regular annual dividend, this amount having been paid for a year or two in the shape of 6 per cent. regular and 1 per cent. extra dividends. Even after this payment there was an appropriation for betterments amounting to $4,100,000 as against $1,680,000 in the previous year, an increase of $2,480,000, or 147 per cent. The income account thus summarized is good evidence of the company's financial power.

Freight earnings increased $2,000,000 and passenger earnings decreased $725,000, the change in each case being about 6 per cent. No table of commodities carried is given, so that it is not possible to tell where the gains in freight traffic were made. The decrease in passenger earnings was, of course, due to comparison with a year which included several months of the St. Louis Exposition. There was spent on maintenance of way $1,550 per mile as against $1,394 in 1905. Maintenance of equipment cost $1,944 per locomotive against $2,211 in 1905, $819 per passenger car against $761 in 1905, and $67 per freight car against $69 in 1905. The largest item of increase under conducting transportation is in station expenses; freight train expenses and telegraph expenses show the next largest increases.

The train load shows an increase of 11 per cent. from 319 tons to 353 tons. Including company freight there was an increase of 12 per cent. from 367 tons to 411 tons. The tons of revenue freight carried one mile increased 12 per cent. against an increase of 6 per cent. in freight receipts. The average rate received per ton-mile was 0.556 cents against 0.587 cents in 1905, a decrease of 5 per cent. On the other hand, and showing the greater efficiency with which the road was operated, receipts per freight train mile increased from $1.87 to $1.96, also a gain of 5 per cent.

The Indianapolis Southern, a projected railroad from Indianapolis southwest to a connection with the Effingham branch of the Illinois Central, was bought in the previous fiscal year. On June 30, 1906, it was consolidated with the Illinois Central branch extending from Effingham, Ill., on the Chicago-Cairo main line west to Switz City, Ind., under the name of the St. Louis, Indianapolis & Eastern. These lines are to be known as the Effingham district of the Illinois Central. The new company has authorized an issue of $10,000,000 first mortgage 5 per cent. bonds, of which $1,000,000

is reserved for purchase of equipment. The Illinois Central owns all of the outstanding bonds, amounting to a little over $7,000,000. The proceeds are to be used for finishing the line from Switz City to Indianapolis. On the western part of the line from Switz City to Effingham (the old Effingham branch) the Illinois Central is to make improvements, reduction of grades, ballasting, etc., estimated to cost over $1,000,000. Another important acquisition during the year was that part of the Tennessee Central from Hopkinsville, Ky., southeast to Nashville, Tenn., 85 miles. The Illinois Central has an option running until June 1, 1908, to purchase this property. Included in this option is the joint ownership with the Southern Railway, which has taken over the western part of the Tennessee Central, of the Nashville Terminal Railroad. Operation of the road from Hopkinsville to Nashville was begun on December 1, 1905.

In order to secure entrance into Birmingham, Ala., trackage agreements have been made with the Mobile & Ohio for use of track between Jackson, Tenn., and Corinth, Miss., 55 miles, with the Southern Railway and Northern Alabama for use of the latter company's tracks between Haleyville, Ala., and Jasper, 40 miles, and with the Kansas City, Memphis & Birmingham (St. Louis & San Francisco) between Jasper, Ala., and Birmingham, 41 miles. Over the intervening distances, namely, from a point near Jackson, Miss., to connection with the Mobile & Ohio, three miles, and from Corinth, Miss., to Haleyville, Ala., 80 miles, lines are to be built by the Illinois Central under separate charters at an estimated cost of $4,380,000. Land has been secured in Birmingham for a freight terminal estimated to cost $1,120,000. The amount expended to June 30, 1906, on the Birmingham line has been $1,271,785. The route of the new line is shown on the accompanying map.

Aside from its splendid credit, the principal advantages which the Illinois Central will bring to the Harriman system are a connection from Omaha to Chicago, bringing the Union Pacific into Chicago, and the best line from Chicago to the Gulf at New Orleans, bringing the Southern Pacific also into Chicago. What effect the Harriman control of the road will have on the trackage privileges which have been granted to the Colorado Southern, New Orleans & Pacific, a Rock Island road, from Baton Rouge, La., to New Orleans, bringing that projected competitor of the Harriman line into the principal Gulf port is not yet clear. This privilege, which could in no way injure the Illinois Central, was given as a more or less direct result of the trackage rights over the Frisco into Birmingham.

A summary of the last two years' operations is given in the following table:

	1906.	1905.
Mileage worked	4,424	4,374
Freight earnings	$34,673,124	$32,607,922
Passenger earnings	10,004,041	10,729,825
Gross earnings	51,636,405	49,508,650
Maint. way and structures	6,855,173	6,095,096
Maint. of equipment	77,050,028	7,804,810
Conducting transportation	18,568,355	18,102,052
Operating expenses	34,302,477	33,084,258
Net earnings	17,333,928	16,424,392
Net income	10,862,339	10,135,342
Betterments and improvements	4,164,739	1,683,886

NEW PUBLICATIONS.

Things That are Usually Wrong. By John E. Sweet. New York: Hill Publishing Co. 5½ in. by 7¾ in.; 52 pages; 50 illustrations. Price, 50 cents.

In the preface the author says that the book is small but that it is his hope that most of the readers will wish there were more of it. It is safe to say that the hope will be realized. In the text itself attention is drawn to a number of items in machine design that are usually wrong because the designers have followed precedent blindly without stopping to think whether or not they were doing the best that could be done. If one were to read between the lines, a fine sermon would be found on the necessity of careful thought in the designing of even the most trivial details of machine work. The preface also says that "should those who buy the book be disappointed they can console themselves with the fact that it did not cost much." As a repair shop foreman who should follow the book's suggestion about counterboring cylinders would save more than his own salary to the company in a year, the book is clearly a good investment and will pay for itself. To quote further: "It is not to be expected that the other old fellows are going to change their patterns or practice, even if convinced that they are wrong. It is only those who think of the best way who are likely to do it; and those who think that the 'best is bad enough.'"

Cost of Locomotive Operation. By George R. Henderson, M. E. New York: 1906. The Railroad Gazette. Cloth; 6 in. x 9 in.; 192 pages. Price, $2.50.

This is a reprint in book form of a series of articles which appeared in the *Railroad Gazette* during 1905. The locomotive is considered as a power plant, and the author, who has had long experience in the motive power department, takes up in detail each of the items which go to make up the cost of delivering power at the drawbar to haul trains. One-third of the operating expenses of a railroad are included under this general head, yet there is little definite information as to how this cost, which annually amounts to $450,000,000, is divided and what effect physical influences have on each item. No attempt has been made to determine absolute figures of cost that could be used without qualification, but the effects of different circumstances on the cost of transportation are discussed at length and a study made of the methods of reducing this to the lowest limit. The chapters are arranged in three general groups: supplies, maintenance and service, and include fuel, water, lubricants, waste, tools, miscellaneous, general repairs, running repairs, renewals, engineers, firemen, hostling and turning, cleaning fires, wiping, inspecting, firing-up and coaling. The book is a critical analysis of the locomotive and its operations, and is of value alike to the designer, the runner and the man in charge of its maintenance and repair.

General Specifications for Steel Railroad Bridges and Viaducts. By Theodore Cooper. Revised Edition, 1906. New York: Engineering News Publishing Co. Pamphlet, paper cover; 7 in. x 9½ in. Price, 50 cents.

Cooper's bridge specifications were first published nearly 25 years ago. They have formed the basis of many similar publications issued since, and need no introduction to bridge engineers the world over. This is the tenth revision, made to meet the requirements of increasing loads and improvements in material and methods of construction. The load diagrams are given from E 30 to E 50. While the specifications are general in their requirements, they are especially intended to cover ordinary railroad bridge spans resting on two supports only. An appendix gives tables of moments, end shears and floor-beam reactions, weights of recent heavy locomotives and relative costs of bridges built for different classes of loading.

Manual of Field Engineering. By H. C. Ives and H. E. Hilts. New York: 1906. John Wiley & Son. Leather, Pocket Size, 136 pages. Price, $1.50.

This is an outline of the methods to be employed in solving the fundamental problems of surveying and geodesy, and was prepared for the use of students in the civil engineering course at the University of Pennsylvania. An appendix gives instructions for making the adjustments of the engineer's transit and level. The book is illustrated with numerous diagrams and forms for recording notes of field observations.

Elements of Gas Engine Design. By Sanford A. Moss. New York: D. Van Nostrand Co., 1906. No. 121 Science Series. Price, 50 cents.

The author of this little book assumes that the reader is familiar with the general features of the gas engine and its operation. He presents in condensed form only the fundamental principles with which a designer of gas engines should be familiar, and no attempt is made to go far into mathematical or constructional details of different types of engines.

CONTRIBUTIONS

Consistency of Proposed New Signal Indications.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I have heard the system of signalling recommended by the Railway Signal Association Committee (*Railroad Gazette*, October 26, page 368) attacked from various standpoints, and have been put to it at times to defend the system. The principal point of attack seems to be "Consistency."

While consistency may in some cases be synonymous with narrow-mindedness, yet I believe it is good, other things being equal, and it is especially good in signalling, where the engineman should meet as little confusion as possible from indications given him.

Now, the conclusion I arrive at is, that the system is absolutely consistent. The indications at and approaching interlockings most severely criticised are shown in the sketch, A to I. *A*, 3, 2, and 1, represents everything normal approaching an interlocking plant. Here No. 2 was attacked, because both arms show caution. This is consistent, for at the interlocking there is a possible medium speed route, and it should have its distant indication as well as the high. In its meaning this is the same as the present arrangement, shown at *D* 2.

It has been asked why *A* 3 should not also have the lower arm at clear, since the lower arm at *A* 2 does not indicate stop. The reason is that there is no medium speed route, as such, between 3 and 1; therefore, there should be no clear medium speed indication.

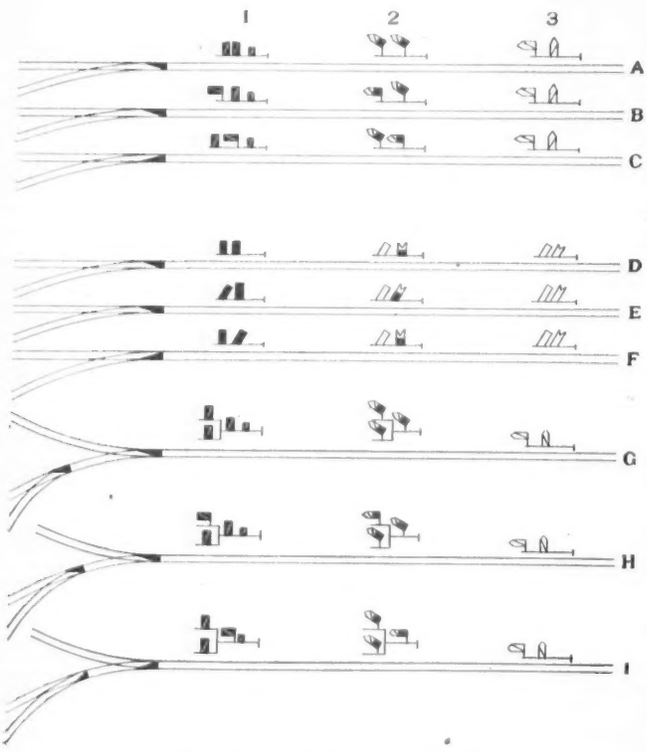
The same applies to *B*, which shows the high speed route clear through the interlocking. In the present case this corresponds to *E*, which shows the main line clear through the interlocking. But B shows more; it shows that although there is a possible medium speed route, it is blocked.

Now consider *C* and *F*. In *C* the medium speed route is clear, and in F the diverging route is clear, but note the difference. At *C* 2 a caution high speed signal is displayed, showing that the high speed route is blocked; but there is a clear medium speed signal displayed, showing that a train may proceed, not "prepared to stop

at the next home signal," but for two blocks at medium speed. The chances are that an engineman getting indication *F* 2 would apply the brakes; whereas, getting *C* 2 he would merely shut off steam. You will have to refer to Mr. Peabody's article on "Cost of Stopping Trains Compared with Cost of Maintaining Interlocking Plants"* to see how much the saving per year capitalized would amount to, but I think it would pay to use *C* 2.

One more point. In the last analysis, why use the different arrangements of lights as between block and interlocking signals? Are not all high interlocking signals to have three arms and consequently three lights? [No; the dwarf is dim and does not count.—Editor.]

You remarked, editorially, two weeks ago, that one defect in the new system was lack of provision for a layout having two or more equally high speed diverging routes. This is true and may prove a serious defect. To follow the committee's theory we must use the same arm for both routes if both are equally safe for the highest speed. Enginemen have been known to get lost, even under the present system of route signaling, as witness the case of a Santa Fe train taking the M., K. & T. tracks at Forth Worth recently. Merely as a suggestion, I have shown a possible solution of the



Old and New Signal Indications.

A, B, C.—Railway Signal Association Committee Recommendations.
D, E, F.—Present practice, two-position.
G, H, I.—For two high-speed routes.

difficulty in *G*, *H* and *I*, which, I think, needs no further explanation except that the right hand signal governs the right hand route, etc. The idea is not entirely original, but was suggested by Mr. Henry Johnson's letter in the *Railroad Gazette*,† and, I believe, is English practice. As to lights in vertical and oblique lines, this arrangement theoretically may not be entirely consistent, but as it would be used only approaching interlockings, this might be tolerable.

This scheme involves the eternal question of bracket posts, but that is beside the point. W. H. A.

Steam Locomotive and Electric Locomotive Power.

New York, Nov. 12, 1906.

To the Editor of the Railroad Gazette:

One of the widespread errors current among engineers is the belief that the steam locomotive is an economical engine. This error forms the basis of the many various estimates of the relative cost of steam locomotive and electric operation recently published. Various test runs with steam locomotives are recorded which give a coal consumption of between 2 lbs. and 2½ lbs. per indicated horse-power-hour. These results have been used in a recent estimate as the actual coal consumption of steam locomotives in service. More conservative estimates place the coal consumption per horse-power-hour in service at from 4 to 7 lbs. By comparing the total coal consumption of the locomotives of several railroads with the useful work done by them, measured at the rim of the drivers, the average coal consumption is found to be between 9 and 15 lbs. per horse-power-hour. The variation is partly due to differences in the quality of the coal. By useful work at the rim of the drivers is here meant the work used to haul the locomotive and the train. The work needed to haul one ton of locomotive or train is assumed to be equal. The work credited to the locomotive is therefore that developed at the drawbar, which can be measured by a dynamometer car, plus this work multiplied by the ratio of weight of locomotive to weight behind the locomotive. A large preponderance of authority can be quoted against the above estimate of coal consumption.

A close inspection of the tests which form the basis for such an estimate shows, however, that they do not give the coal consumption of an average locomotive with an average engineer and fireman under commercial conditions per useful horse-power-hour developed at the rim of the drivers. Careful tests under commercial conditions are few and they support the views here advocated. Among these may be quoted a series of tests made by Bion J. Arnold on the New York Central between Grand Central Station and White Plains. In these tests the power was measured by a dynamometer car behind the locomotive. The length of the runs was 24.75 miles. There was an average of 18 stops in this distance. All the coal used by the engine during the day was charged up. The only power counted was that developed at the drawbar in hauling the revenue trains. One of the purposes was to find the coal consumption per useful horse-power furnished by the locomotive. This was found to be 15.6 lbs. per horse-power-hour. The weight of the locomotive and tender was 107 tons; the average weight of the cars in the trains was 174 tons, and the average speed was 24 miles an hour. The useful power developed at the rim of the drivers has to haul the locomotive and the cars; it is, at moderate speeds, approximately in proportion to the weight hauled. Allowing for this the coal consumed per useful horse-power developed at the drivers is $15.6 \times \frac{174}{281} = 9.66$ lbs. This includes the coal used in firing up, during laying over and during switching. It does not give the average coal consumption per horse-power-hour on a whole system, but refers to the local passenger trains on a short line and to one particular locomotive. Since the coal consumption per horse-power-hour is largely dependant on the care used in firing, on the skill of the fireman and the engineer, and on the train speed the result here found does not give a reliable indication of the amount of coal used per horse-power-hour on the whole system, and when the engineers and firemen are not watched. The conditions of the tests were, however, as closely as possible like those of commercial service. The tests were made October 23 to 25, 1901, and are described in detail in Trans. Am. I. E. E., 1902.

It has been often attempted to measure the coal consumption of locomotives per useful horse-power-hour by means of indicator cards. This method gives directly the coal used per indicated horse-power-hour. The useful work done by the locomotive is then often guessed at by assuming its mechanical efficiency as about the same as that of stationary engines. There is no better way, known to the writer, to determine this mechanical efficiency than to measure by means of a dynamometer car the work done behind the locomotive and to estimate the work done in hauling the locomotive itself. For this latter work the most reasonable assumption is to take, for moderate speeds, the resistance per ton of locomotive the same as per ton of train. If the work of hauling the locomotive is estimated in this way it is found that the average mechanical efficiency of the locomotive, with the partial loads of commercial service, is about 40 to 60 per cent. Locomotive indicator cards, though valuable for judging the efficiency of the boilers, are therefore of little value for finding the useful work done by the locomotive. The low mechanical efficiency of steam locomotives is well established by such comparisons. Tests by means of indicator cards together with erroneous guesses of the mechanical efficiency of steam locomotives form the basis of the current opinions on their coal consumption per useful horse-power-hour.

A direct method of finding the average coal consumption per horse-power-hour of useful work on a railroad is to compare the amount of coal used per year by the locomotives with the work done by them estimated from the train resistance per ton determined by dynamometer car or other tests, and from the number of ton-miles of freight, cars and locomotives. Train resistances per ton vary considerably with the kind of equipment, especially the method of lubrication, with the number of cars per train, the average weight of the cars and of their load and the train speed. European tests can therefore not be used unless confirmed by other evidence. From a consideration of many formulæ giving the results of American tests the writer estimates the train resist-

Railroad Gazette, Oct. 13, 1905.
†Oct. 27, 1905, p. 387; see also Nov. 10, 1905, p. 434.

ance of freight trains at the present speeds to average not over 7 lbs. per ton. The train resistance of the passenger trains of the railroads here considered is estimated for the average schedule speed of about 30 miles per hour at not over 11 lbs. per ton. The train resistances here assumed form the basis of the whole calculation of the work done by the locomotives; a few words in their defence are therefore proper.

Train resistances have been determined by three methods. The latest and most reliable is by means of dynamometer cars measuring the drawbar pull of the locomotive. Two older methods use either indicator cards combined with an estimate of the mechanical efficiency of the locomotive or gravity tests, consisting in observing the speeds of a train running without power on a known grade and calculating from them and the grade the total train resistance. The mechanical efficiency of the locomotive is a much disputed subject. It is the useful work done by the locomotive divided by the work done by the steam on the pistons. The work done by the steam is given by the indicator cards, that in hauling the train by the drawbar pull, that in hauling the locomotive is variously estimated, often at twice the amount needed in hauling an equal weight of train. The definition of the mechanical efficiency of the locomotive is incomplete without a statement of the method of estimating the work done in hauling the locomotive. The mechanical efficiency of the locomotive, like that of any other engine, is quite different at full load and partial load. In actual service the locomotive works most of the time at partial load; its mechanical efficiency, however defined, if defined at all, is generally estimated for full load. Train resistances calculated from indicator cards are, therefore, of little value unless confirmed by other evidence.

The gravity tests give the resistance for trains under the compression caused by the head resistance. This is shown by comparative tests to be greater than the resistance of a train under tension. The latter is the usual condition. All old experimenters are for trains consisting of light cars, and they were generally made by defective methods. They are therefore of little value.

The Burlington brake tests made in 1886 by means of a dynamometer car are the oldest I shall mention. I quote the conclusions derived from them by Mr. A. M. Wellington from his *Economic Theory of Railway Location.*

"The normal tangent freight train resistance is often, and perhaps usually, as low as 4 lbs. per ton, up to speeds as high as 25 miles per hour, running down in cases to 3 lbs. and even less; and, on the other hand, rising in cases as high as 6 or 8 lbs. per ton when the cars are in bad order or against a head or sidewind, or at winter temperatures, these latter figures being a fair working maximum for freight service."

The tests were made with trains weighing behind the tender from 571 to 615 tons of 2,000 lbs. The Westinghouse train consisted of 25 box cars weighing 301 tons:

25 box cars weighing	301.0 tons.
12 loads of 20 tons	240.3 "
Dynamometer car with 15 persons	16.5 "
Way car with 10 persons	13.6 "
Total	571.4 tons.

There were three trains. The Westinghouse train consisted of old cars in excellent running order, with well-worn journals and wheel treads. The average train resistance with speeds of 16 to 25 miles per hour was 4.32 lbs. per ton. The American train was made up of entirely new heavy cars, which had only run some 300 to 500 miles since leaving the shop, and consequently had bearings and wheel treads still comparatively rough, and not fairly representing the average conditions of practice. The mean resistance of three tests was 8.50 lbs. per ton. The train weighed 615 tons. The Eames train, weighing 571 tons, consisting of poorly built, light cars in inferior condition, showed an average resistance of 6.84 lbs. per ton. Each of the three trains had 27 cars, weighing together more than their load.

Mr. A. C. Dennis reports,' in December, 1902, the results of runs of 3,000 miles with dynamometer cars and heavy freight trains. He found the average resistance in winter and summer practically the same. He gives the resistance of empty cars as 9 lbs. per ton, that of cars carrying a load of twice their weight as 4.7 lbs. per ton; that of the load alone at 2.6 lbs. per ton. The load of the average train is about equal to the weight of the cars. The resistance of such a train would be according to Mr. Dennis $\frac{2.6+9}{2} = 5.8$ lbs. per ton.

The *Railroad Gazette*, April, 1899, reports tests with empty and loaded coal cars. They show 5.17 lbs. per ton resistance for loaded and 9.17 lbs. for empty cars. This substantially agrees with the results obtained by Mr. Dennis.

Experiments made in 1885 in Germany on the Breslau-Schmolz line with a dynamometer car give substantially the same results. The cars used had a rigid wheel base of 16 to 23 ft. Some had fixed and some radial axles. At 21.8 miles per hour the average resistance was 4.19 lbs. per net ton with fixed axles and 4.08 lbs. with radial axles.

These tests make the average freight train resistance 4 to 6 lbs. per ton on a tangent. Allowing for the resistance caused by occasional curves and for the waste of power by the use of brakes 7 lbs. per ton appears to be a liberal estimate for the average freight train resistance on the lines hereafter considered. For passenger trains the data are not so satisfactory.

The Baldwin Locomotive Works gives a formula widely used but based on indicator card tests. The wide experience of this company has probably led to an approximately correct estimate of the mechanical efficiency of locomotives. A too low estimate of the train resistance would mean an underestimate of the work done by their engines; this is therefore improbable. The formula is $R = 3 + \frac{V}{6}$, where R is the resistance in pounds per net ton and V is the speed in miles per hour. This gives 9 lbs. per ton as the resistance for an average running speed of 36 miles per hour. Numerous experiments with dynamometer cars have been made in France and England. Mr. Barbier gives a formula as the result of experiments with passenger trains at 36 to 69 miles per hour. Translated to English measures it is $R = 3.2 + 2.5\ V\ \frac{(V+6.08)}{1000}$. This formula gives for 36 miles per hour 7 lbs. per ton.

Mr. J. A. F. Aspinall gives the result of his experiments with English rolling stock in a formula $R = 2.5 + \frac{V^{\frac{5}{3}}}{50.8 + 0.0278\ L}$ V is the speed in miles per hour, L is the length of the train in feet. Taking L = 300 ft. we obtain for 36 miles per hour R = 9.1 lbs. per ton. These foreign experiments agree fairly well with the results of the Baldwin Locomotive Works' formula.

Assuming the resistance on a level tangent, at the average passenger train speeds, at 9 lbs. per ton and adding 2 lbs. for curve resistance and power lost by the use of brakes the work done by the locomotives is probably liberally estimated.

There are some local passenger trains on suburban lines with frequent stops, where the train resistance, inclusive of the loss due to the use of brakes, is nearly twice as large. There are also some fast through trains where the train resistance is about 14 lbs. per ton. These trains represent, however, a small per cent. of the total mileage of passenger trains, and have therefore little influence on the average. More numerous reliable American tests with dynamometer cars are needed to prove the accuracy of the estimates here made; the quoted tests, however, prove in the opinion of the writer their approximate truth. With these train resistances per ton and the total ton-miles per year calculated from data in the annual reports to the stockholders the total work done by the locomotives of whole railroad systems can be calculated.

Following this method with the Lake Shore & Michigan Southern in the year 1905 we find the coal consumption from the annual report to be 1,690,000 tons. For calculating the work of the locotives we find:

Tons of freight hauled 1 mile	5,383,000,000
Car miles of freight and work cars	344,000,000
Passenger car miles	47,645,000
Passenger engine miles	7,588,000
Freight and work engine miles	11,685,000
Switching engine miles	6,468,000

Taking for the average weight of a passenger car 40 tons, of a freight car 15 tons, of a freight locomotive and tender 130 tons, of a passenger locomotive and tender 90 tons, and of a switching engine 80 tons, we obtain the number of horse-power-years to be credited to the locomotives as follows:

For hauling:		H. P. years.
Freight	$\frac{5,383,000,000 \times 7 \times 5,280}{1,980,000 \times 8,760} =$	11,472
Freight and work cars	$\frac{344,000,000 \times 15 \times 36,960}{17,345,000,000} =$	10,993
Passenger cars	$\frac{47,645,000 \times 40 \times 11 \times 5,280}{17,345,000,000} =$	6,382
Passenger engines	$\frac{7,588,000 \times 90 \times 11 \times 5,280}{17,345,000,000} =$	2,287
Fr't and work eng.	$\frac{11,685,000 \times 130 \times 36,960}{17,345,000,000} =$	3,237
Switching trains	$\frac{6,468,000 \times 420 \times 36,960}{3 \times 17,345,000,000} =$	1,929
Total horse-power years		36,300

The switching mileage given in railroad reports is generally estimated at 6 to 8 miles per hour. This is done to credit the switching engines with an amount of work about equal to that done by other engines. The average weight of a switching train is here

estimated at 420 tons, and the actual switching mileage is estimated to be ⅓ of the nominal reported mileage.

The railroad owns 739 locomotives; the amount of work done per locomotive is therefore 49 h.p.-years. The coal used per horse-power-hour is evidently $\frac{1,690,000 \times 2000}{36,300 \times 8760} = 10.63$ lbs. This is the average actual coal consumption per horse-power-hour on the whole Lake Shore system. This result is in the nature of things only approximate, but it is believed to be closer to the truth than any result that can be obtained from a few test runs. It is not vitiated by some of the inevitable errors of test runs, however accurate the observations. It gives the average results, with average firemen and engineers and average locomotives, under the average conditions of the actual traffic. It is possible that there are errors in the annual report; these reports, however, compare the results of different years and large errors would, therefore, be inevitably discovered. The weight of the cars and locomotives and of the average train resistance has been liberally estimated, and the writer believes that the amount of coal used per h.p.-hour is underestimated.

The Lehigh Valley gives, in its annual report of 1905, 519 tons as the average amount of freight carried by a freight train. The average number of cars per train is 36.45, their weight approximately 14 tons each, or a total of 510 tons. The weight of engine and tender is 130 tons. This gives 1,159 tons as the average weight of a freight train. The work per train-mile is: $\frac{11.59 \times 7 \times 5,280}{1,980,000} = 21.63$ h.p.-hours.

The average coal consumption per freight engine-mile is given as 208.4 lbs. The coal used per h.p.-hour is, therefore $\frac{208.4}{21.63} = 9.64$ lbs. About one-half the freight of this road is coal carried down grade. On up-grades helpers are used; there is, therefore, more than one engine-mile per train-mile. The amount of work done per freight engine-mile is, therefore, probably overestimated, and the coal consumption per h.p.-hour is underestimated. This is confirmed by the results obtained for other railroads. The passenger trains have, on an average, 5.2 cars weighing $5.2 \times 40 = 208$ tons. The passenger engine and tender adds 80 tons, making the average weight of a passenger train 288 tons. The work per train-mile is $\frac{288 \times 11 \times 5,280}{1,980,000} = 8.45$ h.p.-h. The coal used per passenger locomotive-mile is 103.9 lbs. The coal used per h.p.-hour is, therefore, $\frac{103.9}{8.45} = 12.3$ lbs. The switching work, which is the least economical, is here not included, and would have to be considered in obtaining the average coal consumption per h.p.-hour on the whole system.

The Chicago & Alton, in its annual report for the year ending June 30, 1906, gives:

Average freight per freight train	418 tons.
Average number cars pr freight train, 30.37, weighing	425 "
Engine and tender, estimated	120 "
Estimated average weight of freight trains	963 "

The coal used per freight engine-mile is given as 201.55 lbs. The work of the freight locomotive per mile is, therefore, $\frac{963 \times 7 \times 5,280}{1,980,000} = 18$ h.p.-hours. The coal used per h.p.-hour is, therefore, $\frac{201.55}{18} = 11.2$ lbs. The report gives the average number of cars per passenger train as 5.25.

Their estimated weight is	210 tons.
Engine and tender	80 "
Weight of passenger train	290 tons.

Work done per mile $\frac{290 \times 11 \times 5,280}{1,980,000} = 8.5$ h. p. h.

Coal used per mile is 109.43 lbs.

Coal per h. p. h. $\frac{109.43}{8.5} = 12.86$ lbs.

This road publishes also the necessary data for calculating the total work done by the locomotives. If calculated as above it is found to be 9,913 h.p.-years. The coal used per h.p.-hour is found to be 14.73 lbs. This coal costs only $1.15 per ton, and is inferior to the coal used farther east. To do this work the road owns 250 locomotives, each producing an average of 40 h.p.-years. Their value is about $250 per h.p.-year of work produced.

The Erie gives, in its report for the year ending June 30, 1905, the necessary data for obtaining the following results. Coal consumption of freight locomotives, 10 lbs. per h.p.-hour; of passenger locomotives, 14 lbs. per h.p.-hour; of all locomotives, 14.23 lbs. per h.p.-hour.

The railroads here considered were selected at random, mainly because of the completeness of their reports. This investigation, therefore, justifies the statement that the average coal consumption of American steam locomotives is approximately between 10 and 15 lbs. per useful h.p.-hour developed at the rim of the drivers.

With electric locomotives, assuming alternate current operation similar to that adopted on the New York, New Haven & Hartford, with steam turbine power stations of at least 5,000 h.p., one electrical horse-power at the station can be produced in ordinary commercial service with an average consumption of 2 lbs. of coal per hour. With an efficiency of ⅔ from the station to the rim of the drivers this means 3 lbs. of coal per h.p.-h. measured at the rim of the drivers as against 3 to 5 times as much with steam locomotives.

It is of interest to find the cost of steam locomotive power per horse-power-year. The Lake Shore gives the cost per locomotive-miles 32.07 cents. The number of locomotive-miles is 25,741,500. This gives $8,256,000 as the total cost of 36,300 h.p.-y., or $227.50 per h.p.-year. This does not include interest and taxes on the cost of the plant.

With electric locomotives, we have the cost at the power stations that of transmission, and that on the locomotives. With stations of 5,000 or more h.p. capacity and a minimum load factor of ⅝, with coal at $1.60 per net ton, one electrical horse-power at station will cost approximately $36 per year. With an efficiency of ⅔ from the station to the rim of the drivers the current for one horse-power-year at the drivers costs $54 at the station. This includes 5 per cent. for interest and taxes on the cost of the power stations.

The cost of transmission varies greatly with the amount of power consumed per mile of track. Assuming alternate current operation with 15,000 volts in the contact conductor, the cost of the transmission plant for a trunk line with maximum train speeds of 80 miles an hour is approximately $5,500 per mile of track. This cost is the same whatever the number and size of the daily trains, provided the distance of the stations is inversely proportional to the square root of the amount of power used per mile of track. Allowing 8 per cent. for interest, taxes and maintenance of the transmission plant, the yearly cost of the power transmission becomes $440 per mile of track.

On a double-track line, with 40 trains per day, the average power consumption per mile of track is about 16 horse-power at the rim of the drivers. This makes the cost of the power transmission $27.50 per h.p.-year. On some lines the traffic will be twice as large, making the cost of transmission per h.p.-year one-half as much. On single track lines the maximum train speeds are much smaller, and an overhead construction similar to that of interurban lines costing about $2,500 per mile of track, can be adopted. Taking 10 per cent. for interest, taxes and maintenance the yearly cost of the power transmission per mile of track becomes $250.

On some single-track lines the power used per mile of track does not exceed 6 h.p. costing for transmission $41.67 per h.p.-year. The cost of the electric current delivered at the locomotive varies therefore from $68 to $96 per h.p.-year. This assumes power produced in steam turbine stations using good coal costing $1.60 per ton, with the average power consumption varying between 6 and 32 h.p. at the rim of the drivers, per mile of track. In some locations cheap water powers will reduce this cost from $43 to $71 per h.p.-year.

The costs incurred on the electric locomotive are not exactly known. They amount to about $75 per h.p.-year. The total cost per h.p.-year developed at the rim of the drivers is therefore approximately $143 to $171, with power derived from steam turbine stations, and it may be only $118 to $146 with a cheap water power. This compares with about $225 for steam locomotive power. Interest and taxes on the cost of the plant required with steam locomotives and on the cost of the electric locomotives have been omitted. These will be about the same for the two cases.

It is generally conceded that electric operation has many advantages much more important than its cheapness. They can, however, not be as accurately estimated, and they are too large a subject to include within the limits of this paper.

JOSEPH MAYER,
Consulting Engineer, Mem. Am. Soc. C. E.

The Federal Employers' Liability Law.

Leading railroads may unite in an effort to overthrow in the courts, on the ground of unconstitutionality, the law passed by the last Congress known as the "employers' liability act," although it is confined to railroads.* The plan of the railroads has become known to the government and the Attorney-General will probably ask leave to intervene in the first case brought under the law to support the constitutionality of the act.

Garrard B. Winston, of Winston, Payne & Strawn, attorneys for the Chicago & Alton, the Michigan Central and other roads, has prepared a statement in which he says:

"At common law no recovery could be had by one employee for negligence of a fellow servant, and contributory negligence on the part of an employee was also a defense to a suit against the em-

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ployer. From time to time, commencing as early as 1862, legislatures of the various states have enacted laws prescribing the rights, liabilities and duties of servant and master. At this day each state has a complete system of laws and decisions on relations of master and servant. By the act of its last session Congress abrogates the common law doctrine, and the federal government controls all litigation arising between carriers engaged in commerce between the several states and their employees, for personal injuries to the latter, and all state laws and the decisions construing the same are, to that extent, nullified. Not only nullified, but Congress goes far beyond the trend of state legislation.

"Contributory negligence is no longer a defense. The doctrine of comparative negligence, long since repudiated by the courts, is resurrected by force of the statute. The freedom of the carrier to contract with its employees is denied. The amount recoverable is unlimited. A mere recital of these innovations upon the law as recognized by the great majority of states is sufficient to show the importance to all common carriers as to whether or not such a law is valid.

"By the use of the words 'cars, engines, appliances, machinery, track, roadbed, ways, or works' Congress extended the provisions of the law over all instrumentalities of companies conducting commerce. The general and sweeping terms, 'every common carrier,' 'any of its agents,' 'any of its officers, agents, or employees,' 'all instrumentalities,' establish the proposition that there was but one idea in the mind of Congress, namely, that as to commerce there shall be no states. Debates in Congress on this act also show conclusively that such was the object sought to be accomplished. Yet the Judicial department has been declaring for 100 years that the power to regulate commerce wholly within a state was a power which the states never surrendered to the federal government, and, as Congress well knew, much of the commerce of common carriers is carried on wholly within the individual states."

"The act in question," concludes Mr. Winston, "is unconstitutional on the single ground that Congress has undertaken therein to invade the rights of the states."

Fifty Cents a Day for Freight Cars.

The meeting which was held in Chicago, Nov. 9, to hasten the adoption of an increased rate of pay for the use of interchanged freight cars appears to have been a shining success. Something like four-fifths of the prominent roads of the country were represented and 40 or more companies, operating more than 100,000 miles of road and owning a million freight cars, indicated their willingness to sign the agreement which was adopted. This agreement, the "Car Hire Agreement"—so designated to distinguish it from the agreement which is now in force, under the auspices of the American Railway Association—is distinctly supplemental to the Per Diem Rules Agreement, and is, of course, entirely independent of the American Railway Association, although it has been adopted and will be carried out entirely in harmony with the action of the association. The agreement is in substance as follows:

It is mutually agreed, jointly and severally, by and between the several railroad companies subscribing and parties hereto, that on and after Dec. 1, 1906, settlement among themselves for the use of freight cars of the said subscribing companies will be made at the rate of 50 cents per car per day, without penalty for delay, and that each subscribing company will account and pay for the use of said cars to each of the other subscribing companies accordingly.

It is further understood that this agreement in no wise affects the provisions of the Per Diem Rules Agreement, except as to the rate for the use of freight cars and the penalty for delay, between the parties to this agreement.

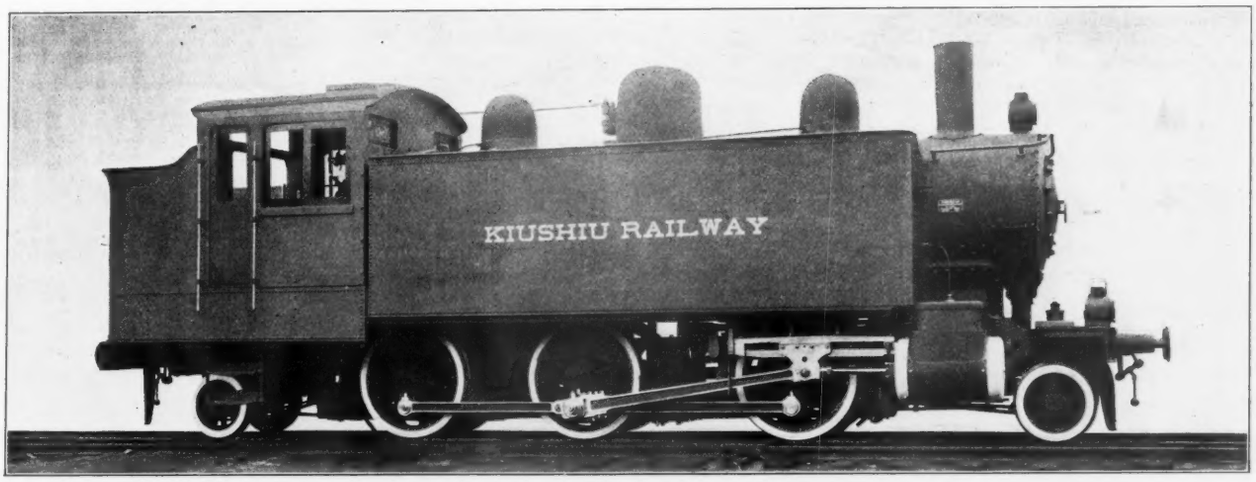
All disputes arising under this agreement shall be settled by a special committee appointed for the purpose, to be known as the Car Hire Committee.

This agreement shall terminate on July 1, 1907, unless it shall be extended, modified or dissolved, by the vote of the majority of the signers thereto, owning two-thirds of the cars represented, such action to be taken at a meeting of said signers, called by the Car Hire Committee on 10 days' previous notice.

The meeting was presided over by Mr. E. W. McKenna, Second Vice-President of the Chicago, Milwaukee & St. Paul, and the Secretary was Mr. W. F. Allen, Secretary of the American Railway Association. The Car Hire Committee will consist of Arthur Hale (B. & O.), chairman of the Car Service Committee of the American Railway Association; Julius Kruttschnitt, of the Southern Pacific, and F. A. Delano, of the Wabash. The meeting could not agree on any definite action looking to the cure of diversion abuses, but this committee will take up the question and try to formulate a rule.

Double End Tank Locomotive for the Kiushiu Railway, Japan.

This locomotive is one of 24 double-end tank locomotives recently built for the Kiushiu Railway (Japan) at the Schenectady Works of the American Locomotive Company. They are intended for heavy passenger and fast freight service and have a large tank capacity for engines of their size. Their tractive power is 20,260 lbs. The general dimensions are as follows:



Double End Tank Locomotive Built by the American Locomotive Company for the Kiushiu Railway, Japan.

Total weight, in working order	132,000 lbs.
Weight on drivers	92,000 lbs.
Diameter of drivers	48 in.
Driving wheel base	13 ft. 6 in.
Total wheel base	29 ft. 2 in.
Cylinders	17 in. x 22 in.
Working steam pressure	180 lbs.
Diameter of boiler	54 in.
Number of tubes	166
Length of tubes	12 ft. 6 in.
Diameter of tubes	2 in.
Total heating surface	1,180 sq. ft.
Firebox, material—door sheet, crown and sides	Copper
" material—tube sheet	steel
Firebox, length	86 in.
Firebox, width	29½ "
Grate area	17.7 sq. ft.
Tank capacity	2,500 Imp. gals.
Coal capacity	4½ tons.

$$\frac{\text{Weight on drivers}}{\text{Tractive effort}} = 4.55$$

$$\frac{\text{Tractive effort} \times \text{diam. of drivers}}{\text{Total heating surface}} = 825$$

$$\frac{\text{Total heating surface}}{\text{Grate area}} = 66.7$$

$$\frac{\text{Firebox heating surface}}{\text{Total heating surface}} = 0.085$$

$$\frac{\text{Weight on drivers}}{\text{Total heating surface}} = 78$$

$$\frac{\text{Total weight}}{\text{Total heating surface}} = 112$$

Volume of two cylinders = 5.8 cu. ft.

$$\frac{\text{Grate area}}{\text{Cylinder volume}} = 3.06$$

Accident Bulletin, No. 20.

The Interstate Commerce Commission has issued Accident Bulletin No. 20, giving the record of railroad accidents in the United States during the three months ending June 30, 1906, and yearly tables for the 12 months ending with June. The number of persons killed in train accidents in the quarter reported was 194, and of injured 3,031. The total number of casualties from train accidents and other causes was 16,937 (933 killed and 16,004 injured). These accidents are classified in the following table. These reports deal only with (*a*) passengers and (*b*) employees on duty:

TABLE No. 1.—*Casualties to Persons—April, May and June*, 1906.

	Passengers.		Employees.		Tot'l persons reported.	
	Kil'd.	Inj'd.	Kil'd.	Inj'd.	Kil'd.	Inj'd.
Collisions	11	839	76	826	87	1,665
Derailments	16	558	73	476	89	1,034
Miscellaneous train accidents	..	20	18	312	18	332
Total train accidents	27	1,417	167	1,614	194	3,031
Coupling or uncoupling	..	.....	68	813	68	813
Other work about trains, etc.	..	.....	72	3,790	72	3,790
In contact with overhead bridges, structures at side of track, etc.	4	12	35	372	39	384
Falling from cars or engines or while getting on or off	37	472	164	2,598	201	3,070
Other causes	13	577	346	4,339	359	4,916
Total, other than train accidents	54	1,061	685	11,912	739	12,973
Total, all classes	81	2,478	852	13,526	933	16,004

The total number of persons here recorded as killed (933) is less than in the last preceding quarter, but it is more than in the corresponding quarter of 1905. The same is true of the number of employees killed in coupling accidents. In considering train accidents alone, however, there is a gratifying diminution both in passengers killed and employees killed, compared with either of the two earlier quarters mentioned. These comparisons, tabulated, are:

	Quarterly Bulletins—		
	No. 20.	No. 19.	No. 16.
1. Passengers killed in train accidents	27	62	41
2. Employees killed in train accidents	167	212	221
3. Employees killed, coupling	68	84	49
4. Total passengers and employees killed	933	1,124	886

In the first of these items the totals have been swelled by great disasters in nearly every quarter for two years. In Bulletin 16 there are two well remembered derailments, killing 34 passengers, and in Bulletin 19 one collision, killing 34 passengers and employees. In the present bulletin this feature is not so bad, yet there is one disastrous butting collision of passenger trains that killed 10 passengers and employees, and one derailment killing 9 passengers.

The total number of collisions and derailments was 3,103, as follows:

TABLE No. 2.—*Collisions and Derailments.*

	No.	Loss.	Persons— Killed.	Injured.
Collisions: Rear	340	$324,929	31	537
" Butting	170	224,196	17	520
" Trains separating	168	61,454	..	97
" Miscellaneous	910	352,512	39	511
Total collisions	1,588	$963,091	87	1,665
Derailments due to:				
Defects of roadway, etc.	291	$236,351	9	321
Defects of equipment	664	581,428	9	152
Negligence of trainmen, signalmen, etc	87	103,148	14	152
Unforeseen obstruction of track, etc.	62	98,546	14	78
Malicious obstruction of track, etc.	17	19,602	1	17
Miscellaneous causes	394	371,758	42	314
Total derailments	1,515	$1,410,833	89	1,034
Total, collisions and derailments.	3,103	$2,373,924	176	2,699

The following table, No. 2*a*, is a list of train accidents in which the damage is reported at $10,000 or over, and other notable cases:

TABLE 2*a*.—*Causes of Thirty Prominent Train Accidents* (*Class A*).

[NOTE.—R. stands for rear collision; B., butting collision; M., miscellaneous collisions; D., derailment; P., passenger train; F., freight and miscellaneous trains.]

COLLISIONS.

No.	Class.	Kind of train.	Killed.	Injured.	Damage to engines, cars, & roadway	Reference to record.	Cause.
1	R.	F. & F.	0	0	$700	2	Approached station too fast; misjudged distance.
2	R.	F. & F.	1	4	2,187	21	Too high speed in fog; engineman did not see flagman; engineman, who was killed, had been on duty 17½ hours.
3	B.	P. & P.	0	38	2,500	49	Operator omitted two words in writing a meeting order.
4	B.	P. & P.	10	38	4,000	22	Pilot misinterpreted despatcher's order. See note in text below.
5	B.	F. & F.	1	5	4,000	27	Operator failed to deliver order. See note in text below.
6	R.	P. & F.	0	1	4,436	51	Engineman, 27 years' experience, ran past automatic signal indicating stop.
7	R.	P. & F.	1	21	4,800	23	Clear block signal given to passenger train while an empty engine was in block section. See note in text below.
8	R.	F. & F.	0	2	6,200	50	Engineman ran past automatic signal indicating stop; brakeman riding on engine discharged for not seeing signal and taking measures to stop train.
9	B.	P. & F.	0	23	7,000	47	Operator, 3 months' experience, failed to deliver despatcher's order.
10	B.	P. & P.	1	10	10,377	48	Men in charge of southbound train overlooked meeting point.
11	B.	F. & F.	1	4	10,082	53	Conductor, engineman and whole crew (on duty 16 hours) overlooked meeting orders; orders delivered to them only 30 minutes before.
12	B.	F. & F.	0	1	12,000	28	Conductor and engineman, eastbound, misread orders.
13	B.	P. & P.	0	5	12,050	45	Northbound encroached on time of southbound.
14	B.	P. & F.	0	30	14,579	57	Signalman failed to put block signal in position after passage of work train. See note in text below.
Total.....			15	187	$101,011		

DERAILMENTS.

1	D.	P.	1	8	$1,255	11	Two cars of a passenger train having been detached at junction ran back down grade and were derailed at a curve; brake connections defective; one bolt missing; one hook so weak that it straightened out; brakeman set hand-brakes, but these defects thwarted his work.
2	D.	F.	0	0	2,800	59	Ran off derail switch; air brakes inoperative; brake-pipe cocks had been maliciously closed in three places; conductor had not properly tested air brakes.
3	D.	F.	0	0	5,110	17	Air brakes failed on steep grade; brake-pipe found closed near engine; cause not explained; engineman disobeyed rule to stop at head of grade.
4	D.	F.	1	1	6,500	58	Air brakes failed on 3.4 per cent. grade; brakes not tested after detaching helping engine; conductor and engineman discharged; conductor's service as such, three months'; engineman's as such, two months.
†5	D.	P.	9	18	6,710	40	Unexplained; speed, 12 miles an hour; switch at point of derailment found broken may have been the cause.
6	D.	P.	0	4	7,825	14	Overhead bridge burned and fell on track.
7	D.	P.	0	0	8,000	38	Rail maliciously misplaced, presumably by dissatisfied track laborers.
8	D.	F.	0	0	10,000	67	Loose wheel.
9	D.	P.	0	2	10,000	43	Unexplained; speed, 50 to 60 miles an hour on 1 per cent. descending grade; derailment occurred on bridge; track in good condition.
10	D.	P.	1	35	11,000	63	Misplaced switch; left misplaced by men of freight train over an hour before. See note in text below.
11	D.	P.	0	21	12,509	64	Excessive speed on track not well ballasted.
12	D.	F.	0	0	13,400	32	Steel dump car with top-heavy load; speed, 30 miles an hour.
13	D.	F.	2	2	16,000	12	Runaway; air brakes ineffective; conjectured that angle cock had been closed purposely or accidentally by a tramp.
14	D.	F.	0	3	18,600	33	Runaway on 3 per cent. grade. See note in text below.
15	D.	P.	0	0	21,700	72	Open draw. See note in text below.
16	D.	P.	0	2	27,900	4	Ran into wreck of freight trains. (Collision No. 1.)
Total.....			14	96	$179,300		
Grand total.			29	283	$280,911		

Collision No. 4* occurred about 11 p. m., and was between two passenger trains running on a single-track branch line, in consequence of an obstruction on the double-track main line, which was their usual route. Being on an unusual route, the enginemen were guided by "pilot men," and the pilot man, being the only person on the train fully acquainted with the road, was chiefly responsible for seeing that the movement of the train was made in conformity to the rules. The pilot of the west-bound train was mainly at fault. He had received a dispatcher's order to run to a signal tower designated "S T," which was at the end of the double-track section of the branch, and at this tower he was to receive further orders, or, in the absence of such orders, to wait there. When he arrived at "S T" the telegraph operator at the tower delivered to him a message in regard to reducing speed over a piece of new track which he was to traverse, and he carelessly took it for granted that this message was the dispatcher's order which he was expecting, and he proceeded with his train (on the single-track line). As soon as he read the order and found that it did not give him any right to proceed, he stopped the train and sent the fireman back to consult the conductor. The conductor, however, on receiving the order to run to "S T" had misread it, taking it for an order to run to "S J," which was the name of a tower some distance beyond. The conductor therefore sent back word by the fireman that his order was the same as that which had been given to the pilotman, and that it gave the train the right of road to "S J." On this the pilot assumed that he himself had been mistaken in reading his order, and proceeded, though with a doubt in his mind. Before he had settled the doubt, however, the east-bound train was met, and the wreck occurred. The report says that the dispatcher's order was plainly written, and that there was no reason for mistaking the "T" for a "J." The conductor and the pilot were both experienced men. The

*Clover Creek Junction, May 4.
†Louisville, May 28.

conductor had been on duty about three hours. The engineman had been on duty all day, about fourteen hours, except that in the middle of the day his train was laid up about five hours at the terminus of its run.

In the case of collision No. 5 the operator who failed to deliver a meeting order and thereby caused a collision had at the time three other orders for delivery to the same train. The rules require that the operator report to the dispatcher the numbers of orders to be delivered to a given train, and also that he deliver to the conductor of the train a clearance card on which the numbers of the orders are entered. Concerning one of the four orders there was some discussion between the dispatcher and the operator, and the operator definitely stated that he had that order; but he neglected to enter it on the clearance card. The rules also require that meeting orders shall be sent to the operator at the station where the trains are to meet, but in this case the dispatcher, being unable to get a response from the operator at the meeting point, neglected to carry out the rule.

Collision No. 7 appears to have been due to carelessness in the management of permissive block signaling. The passenger train was given a clear block signal when the block was occupied by an empty engine which had preceded the passenger train. This engine was running on a caution card on account of the presence of still another engine in the block ahead of it. It appears that the signalman at the outgoing end of the block had not been advised, or denied having been advised, of the entrance of the second engine, and he authorized the giving of a clear signal to the passenger train before the block was clear.

Collision No. 14 was due to confusion at a block-signal tower where trains pass from a two-track line to a three-track line. A work train passed to the northermost track of the three-track line and stopped. The next following train, a fast passenger train, was due in about fifteen minutes, and it should have been run on to the middle track of the three-track line; but the signalman neglected to return the signal to the stop position after the passage of the work train, and the fast train when it came on therefore received a clear signal for the northernmost track, the one occupied by the work train. It appears that there was no track circuit or other arrangement to insure the movement of the signal from the clear to the stop position after the passage of the work train. It was the duty of the flagman of the work train, according to the rules, to go back with a flag so as to be ready to stop the passenger train, but it appears that he depended on the signalman in the cabin to provide this protection—though without looking at the signal to see whether or not the signalman had actually done so.

Derailment No. 10 was a disaster to a fast passenger train which ran through a misplaced switch that could be seen by the engineman only a few seconds before he reached it—that is to say, about 500 ft. away. The switch had been left in the wrong position by a brakeman of a freight train something over one hour before. The station agent is censured by the superintendent for not noticing that the switch had been left in the wrong position. There was no distant signal connected with the switch. The negligent brakeman had been in the service about two years. The conductor of the freight train had been in the service seventeen years, but his record was quite faulty.

Derailment No. 14 was primarily due to the runaway of a heavy train on a 3 per cent. grade, though the damage is believed to have been immediately due to the breaking of a wheel; but the whole trouble could undoubtedly have been prevented if the conductor of the train had made proper use of the air brakes. The train consisted of 37 cars of ore, 27 of them being steel cars carrying 50 tons each, and 10 of them wooden cars carrying 25 tons each. Shortly after beginning the descent of the grade the speed became uncontrollable. It is believed that a tramp rode on one of the cars and that he, without knowing what he was doing, moved the handle of an angle cock so as to close the train line air pipe near the engine. The increase in the speed occurred so rapidly that all of the three men on the front of the train jumped off; but the train reached a safety siding before the speed got above 35 miles an hour, and therefore it should have been stopped without serious damage. Marks on the ties showed, however, that one of the cars had been off the track for nearly a mile, and this car had the broken wheel. The broken wheel knocked the switch rails out of place, causing the derailment of the following cars. Before the broken car jumped the track the conductor had detached the caboose from the train, after closing the angle cocks in the air pipe both of the cabcose and of the last freight car. If, instead of doing this, he had applied the air brakes, in all probability he would have been able to stop the train or greatly to check its speed.

Derailment No. 15* was caused by the carelessness of the attendant at a drawbridge, who opened the draw for the passage of a vessel when the passenger train was approaching and after the engine of the train had passed the stop signal. This signal was about one-third mile away from the bridge, and it appears that the bridge tender set it in the stop position immediately *after* the engine had passed it. The signal being so far away from the bridge, and there being no lock to prevent the attendant from moving the draw after the train had passed the signal, there was time to move the draw a few feet after the signal had been set and before the train reached the draw span. Though the train ran upon the partly opened draw and the engine sank in the river, all of the occupants of the train escaped without serious injury.

*Marion, N. J., June 2.

YEARLY TABLES.

This bulletin completes the publication of the accident records under the law of March 3, 1901, for five years, and the double column table (A) gives the aggregates for the year ending June 30, 1906, of the items which are given in Table No. 1 of the quarterly returns. The total number of casualties shown in Table A is 70,934 (4,225 killed and 66,709 injured). The totals of these yearly tables are not comparable with those given in the Commission's Annual Statistical Reports, as the monthly reports deal only with accidents to passengers and to employees while on duty.

TABLE A.—*Summary of Casualties to Persons, Year ending June 30, 1906.**

	Passengers (a and b)		Persons carried under agreement, etc. (bb).		Total, (a, b and bb).		Trainmen.		Trainmen in yards.		Yard trainmen (switching crews).		Other employees.		Total employees.		Total all persons.	
	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.
Collisions	89	3,596	31	409	120	4,005	331	2,348	53	669	43	429	57	463	484	3,909	604	7,914
Derailments	48	2,341	12	315	60	2,656	220	1,385	17	209	27	232	49	290	313	2,116	373	4,772
Miscellaneous train accidents.†	0	86	2	31	2	117	61	1,036	5	215	10	103	6	104	82	1,458	84	1,575
Total train accidents	137	6,023	45	755	182	6,778	612	4,769	75	1,093	80	764	112	857	879	7,483	1,061	14,261
Coupling or uncoupling	...	.....	...	.....	...	.....	101	1,060	65	695	130	1,646	15	102	311	3,503	311	3,503
Other work about trains or at switches	...	.....	...	.....	...	.....	75	7,303	42	2,871	55	2,735	96	2,945	268	15,854	268	15,854
In contact with overhead bridges, etc.	7	30	1	16	8	46	80	753	27	280	16	402	9	62	132	1,497	140	1,543
Falling from cars or engines, or while getting on or off	140	1,962	4	65	144	2,027	295	4,436	98	2,252	175	3,156	145	1,409	713	11,253	857	13,280
Other causes	66	2,118	18	216	84	2,334	197	591	93	394	119	363	1,095	14,586	1,504	15,934	1,588	18,268
Total, other than train accidents.	213	4,110	23	297	236	4,407	748	14,143	325	6,492	495	8,302	1,360	19,104	2,928	48,041	3,164	52,448
Total, all classes	350	10,133	68	1,052	418	11,185	1,360	18,912	400	7,585	575	9,066	1,472	19,961	3,807	55,524	4,225	66,709

*The passengers have been divided into three classes: Class *a* includes all ordinary passengers; Class *b* includes passengers traveling on freight trains; Class *bb* includes persons who are customarily carried on trains under special arrangements, such as postal clerks, and express messengers, employees on Pullman cars, newsboys, live stock tenders, and men in charge of freight.
†Including locomotive boiler explosions.

TABLE B.—*Casualties for Three Years; Years ending June 30.*

	1906		1905		1904	
	Kil'd.	Inj'd.	Kil'd.	Inj'd.	Kil'd.	Inj'd.
Passengers: In train accidents	182	6,778	350	6,498	270	4,945
Other causes	236	4,407	187	3,542	150	3,132
Total passengers.	418	11,185	537	10,040	420	8,077
Employees: In train accidents	879	7,483	798	7,052	844	6,990
In coupling accidents	311	3,503	243	3,110	278	3,441
Overhead obstructions, etc.	132	1,497	92	1,185	116	1,210
Falling from cars, etc.	713	11,253	633	9,237	700	9,371
Other causes	1,772	31,788	1,495	24,842	1,429	22,254
Total employees	3,807	55,524	3,261	45,426	3,367	43,266
Total, passgrs.-employees.	4,225	66,709	3,798	55,466	3,787	51,343

TABLE C.—*Collisions and Derailments for Two Years Ending June 30.*

	1906.			1905.		
	No.	Persons—Killed.	Inj'd.	No.	Persons—Killed.	Inj'd.
Collisions: Rear	1,722	169	2,427	1,493	152	2,085
" Butting	866	251	2,733	707	304	2,453
" Trains separating	901	9	375	972	11	369
" Miscellaneous	3,705	175	2,379	3,052	141	2,204
Total collisions	7,194	604	7,914	6,224	608	7,111
Derailments due to:						
Defects of roadway, etc.	1,287	38	1,608	1,007	50	1,446
Defects of equipment.	2,811	42	802	2,605	40	798
Negligence, train or signal men, etc.	391	54	494	341	40	418
Unforeseen obstruction of track, etc	300	76	456	332	177	646
Malicious obstruction of track, etc.	65	16	94	76	34	196
Miscellaneous causes	1,407	147	1,318	1,010	115	1,334
Total derailments.	6,261	373	4,772	5,371	456	4,838
Total collisions and derailmts.	13,455	977	12,686	11,595	1,064	11,949

Damage to cars, engines and roadway: for 1906, collisions $5,319,758; derailments $5,339,431, total $10,659,189. For 1905, collisions $4,849,054, derailments $4,862,602, total $9,711,656.

Drawbridge Floors and Locks.

In view of the recent drawbridge disaster and the discussion, in connection therewith, of bridge floors and the interlocking of bridges with the signals, the following notes concerning drawbridges in and near New York City may be found of interest.

The drawbridges of the Central of New Jersey have floors of 12-ft. ties for each track, laid 14 in. apart, center to center; and have outside guard timbers 5 in. x 8 in., laid 13 in. from the outside of the running rail on both sides of each track. Inside steel guard rails—of the same size as the running rails but a half-inch lower in consequence of not being set on tieplates—are laid the whole length of the bridge, the distance between these and the running rails being 8 in. between heads. At the approach end of the bridge the inside guard rails are bent so as to come to a point in the center of the track, the radius of the curve being 344 ft. An old No. 6 frog point, beveled for 1 ft., is used at the end, which is 40 ft. outside of the end of the draw. Miter joints are provided at the ends of draws and expansion joints, farther out, when necessary, to prevent creeping.

The most important drawbridge on this road near New York is that in the main line across Newark bay, where vessel movements are very frequent throughout the day and where there are two separate Scherzer lift bridges, each giving an 85-ft. opening. These bridges were described in the *Railroad Gazette* of Feb. 26, 1904.

These bridges, when down, are fastened at the end by hooks, and the hooks, as well as the locks in the rails of the track, are controlled by the interlocking in the signal cabin, which is electro-pneumatic. At these bridges the signal cabin is at the level of the tracks and is supported on brackets far enough to one side to give a view, in each direction, along the tracks, outside of the bridge trestles. The gasolene engines, which move the bridge, are in a house 25 ft. above the tracks, but the movement of the engines is controlled by the signal man below; and when he has closed the bridge and given clear signals for a train to proceed, the bridge engineer is powerless to move the bridge.

When a vessel is seen approaching, the first act of the signal man is to set "navigation signals" to indicate to the approaching vessel which of the two draws is to be opened for it. (This, however, does not give the vessel any authority to pass the bridge—this signal is given by the lifting of the draw, and the presence of the draw across the channel is the daylight "stop" signal.) The next move of the signal man is to set the signals against trains, though this is not dependent on the setting of the navigation signals. He then opens the derailing switches on the approach. Then he unlocks the facing-point locks in the tracks at the ends of the draw, and the bulkhead lock. Next he withdraws the hooks which fasten the outer end of the draw span and then releases the engine in the upper tower. Having done all this he signals the bridge engineer to raise the draw.

The drawbridges of the Delaware, Lackawanna & Western have no inside guard rails, but the rails of the track are locked down at the ends of the draw with a lock which, in principle, is like the common facing-point lock used on interlocked switches. A typical bridge of this company is that over the Passaic river at Newark, N. J., though it differs from most drawbridges in having tracks on two decks, the upper and the lower. The main tracks are on the upper level; and the lower level, which was the grade of the road before the recent elevation of the tracks, is occupied by a freight-yard track. This bridge consists of a single swing span 221 ft. long. The ties of the floor are 16 in. apart, center to center, and the outside guard timbers are 5 in. x 8 in. The rails of the track at the end of the draw which are lifted are 15 ft. long and extend beyond the end of the draw 1 ft. The miter joints at the ends are 7½ in. long. The rail shoes, holding the movable rails in place, constitute a trough 3 in. high, being made of angles 3 in. x 3½ in. The outer side of this trough flares out at the top, the angle iron being bent to a radius of 6 in.

The wedges at the ends of the bridge and the cranks which lift the rails are connected by gearing to a longitudinal shaft and are worked simultaneously by means of the engine which turns the bridge.

The interlocking of the bridge track with the signals which govern the passage of trains over the bridge, is entirely separate from the apparatus here described and, as already intimated, consists of a plunger which enters a hole in a tierod. The plunger must be in place in the rod before the signal man can move the levers by which he clears the signals to permit the passage of trains; and, on the other hand, he must have set the signals in both directions at "stop" before he can withdraw the plunger preparatory to opening the bridge.

The standard bridge floor of the New York Central is made of yellow pine ties 8 in. wide and 10 in. deep laid 12 in. apart, center to center, and of sufficient length to extend 6 ft. out from the center of the outside track, or 3 ft. 4 in. outside of the outside rail. The longitudinal guard timbers fixed on the outer ends of the ties are 8 in. wide and of a depth equal to the height of the rail. They are notched 1 in. down between the ties. They are bolted to every third tie and are chamfered one-half inch on the upper edges. On double track bridges there is a similar timber in the middle, covering the butt joints between the ties at that point. On four track deck bridges there is a guard timber at the inside of each of the outer tracks, and on through bridges these guards are provided for all the tracks.

In each track there are inside guards (steel rails), the space between these and the running rails being 8 in. between heads. The inside guard rails are bent so as to come to a point in the center of the track not less than 50 ft. beyond the bridge on the approach side. On deck bridges on four-track lines the inside guard rails are omitted on the two inner tracks.

The locking of drawbridges on the New York Central provides for interlocking between the rails of the tracks, in position, and the signals. The following is a description of the locking devices of the four-track swing drawbridge over the Harlem river at 135th street, New York City, five miles north of the Grand Central Station.

The device for raising the ends of the bridge is such that the bridge will be properly centered in raising the ends. The lift rails at the ends of the draw are mitred.

The road here is equipped with the controlled manual block system and the bridge is interlocked and protected by a mechanical interlocking plant having two machines, one at either end of the draw. These are interconnected by mechanical connections extending over the draw span.

The usual home and distant signals are provided with derails placed 300 ft. from the end of the draw span. The signals are bolt-locked with the derails so that the signals cannot be cleared unless the derails are properly set.

The lift rails at the ends of the draw have a switch point lock for each lift rail point, so that the levers in the tower cannot be moved to clear the signals unless all the rails are lowered into their proper position. In addition, the lever controlling the draw unlocking device, making possible the raising of the lift rails, is controlled by a lever in the interlocking machines, thus placing the control of the unlocking of the bridge in the hands of the signalmen operating the signals.

On the closing of the draw it is locked in position by the bridge tender through the operation of the steam locking devices. The bridge rails are simultaneously lowered into position. The signalmen in the towers at the ends of the draw lock the bridge lock lever in the engine room and then work the lever to lock the lift rails in their lowered position. The working of this interlocking lever locks the previously operated lock lever, in addition to the bridge lock, so that the lever cannot be moved. On the locking of the lift rails in position, the derails are closed, and the home and distant signals may then be cleared.

In addition to the regular home and distant signals, there is a "smash" signal on the approach side of the draw for each track. These signals are placed on the home signal post, about 10 ft. above the top of the rail, and project over the nearest rail so that the arm will be hit by a train passing the signal when it indicates "stop." If a smash signal is broken, it furnishes positive evidence that the home signal has been over run.

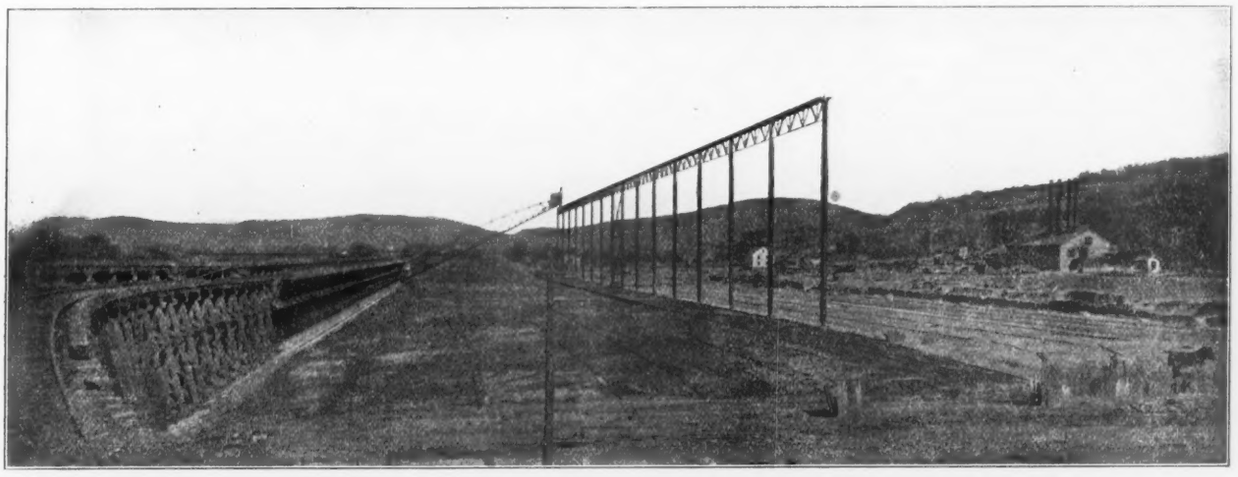
New interlocking is to be installed at this bridge, in connection with the electric automatic signals to be put in use when the line is equipped for electric propulsion of trains. This will be of the electric type, with home and distant signals motor-operated and controlled by track circuit, as well as by the levers of the interlocking machine. The derails and locks on the draw will be operated by motor-operated switch movements which have automatic locking devices to insure correspondence of the movement with the position of the controlling lever.

In addition to the locking of the starting lever of the bridge and also the lift rails, a circuit controller will be placed on each lift rail point, to break the circuit controlling the home signal. If the rails are not in place for the passage of trains, the circuit breaker will prevent the clearing of the signal, even though the interlocking connections might be maliciously tampered with and the home signal lever to be improperly reversed.

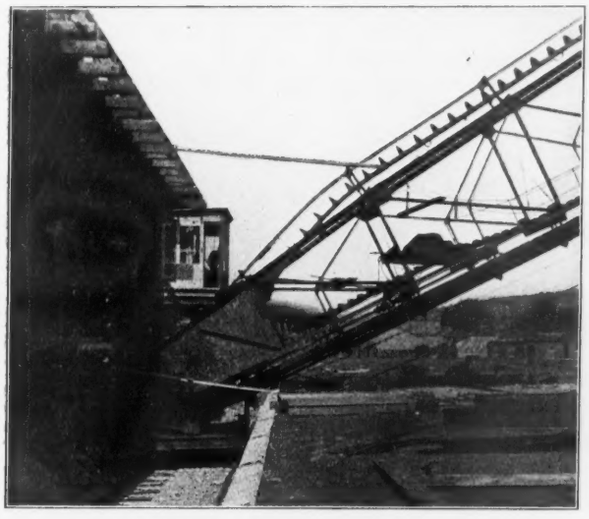
The management of the Bavarian State Railroads has called the attention of its subordinates who exercise authority over employees and laborers to the overbearing and insulting manner of exercising their authority which some of them, and especially those in the lower ranks, too often indulge in. The management desires the intercourse between those in authority and their subordinates to be conducted always in a friendly manner, even when strict orders and reproofs are necessary. Firmness and strict discipline should be exercised, but without unnecessarily wounding the feelings of the men, who should always be made to feel that they have the good will of the management.

Anthracite Coal Storage.

The problem of storing anthracite coal through the dull season is an important one with the coal mining and carrying companies. The rush orders during the fall and winter tax the mines beyond their capacities and the falling off during the summer reverses conditions so that only the storage of enormous quantities of coal permits the continuous operation of the mines from one end of the year to the other. When trade is dull the coal goes to the piles, and when a rush of orders comes the piles are drawn upon to meet the demands. The location of a storage plant is governed by cost of the site, conformation of the ground for the trackage necessary to the switching and disposal of cars, accessibility of the mines, and tidewater and railroad shipping facilities.



Coal Storage Plant of the Lehigh Valley at Ransom, Pennsylvania.



Foot of Trimmer, Ransom Coal Storage Plant.

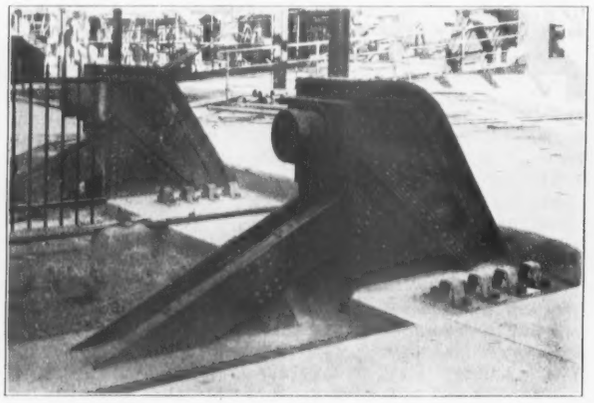
The Dodge system of storing anthracite usually consists of two stationary trimmers, which are conveyers supported by shear trusses, for piling the coal, and a conveyor working in a tunnel between the trimmings for transferring the coal back from the piles to the cars. A series of such groups constitutes the plant of the Philadelphia & Reading at Abrams, Pa., shown in the accompanying photograph. This plant has a capacity of 500,000 tons. A modification of this system has recently been installed by the Lehigh Valley at Ransom, Pa., in which a single trimmer does all the work. The lower end is supported on a truck traveling on a track of 10-ft. gage, and the upper end on a mono-rail runway which is carried on a structure supported by 16 steel columns 83 ft. high. The columns are built up of sections of ½-in. boiler iron and are 30 in. in diameter in the middle, tapering to 24 in. at the bottom and 26 in. at the top; they are filled with concrete. The columns are mounted on ball-and-socket joints and are stayed from the tops by 1¼-in. steel cables on each side, those on the trimmer side being a few inches below the lower side of the trimmer to give it clearance. The runway is 902 ft. long and the storage floor is 1,244 ft. long. The floor has a slope of 2 per cent. to give proper drainage. The trimmer weighs 66 tons, and its span from the center of the runway to the center line of the track is 186 ft. The lower end is pivoted on a steel pin 4 in. in diameter, and the upper end is also suspended in such a way as to allow considerable flexibility, so that one end may gain as much as 20 ft. over the other in its trans-

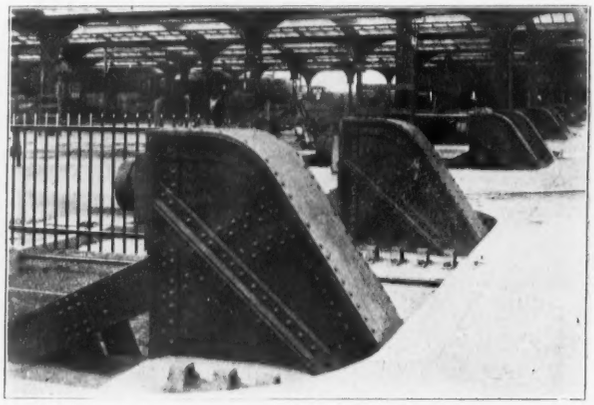
Coal Storage Plant of the Philadelphia & Reading at Abrams, Pennsylvania.

verse movement across the floor of the yard. The motive power for this movement is furnished by a 50 h.p. motor, which can be seen in the photograph of the lower end of the trimmer. This takes its current from a third rail mounted on the side of the trestle in which are the receiving bins. The flight conveyor carried on the trimmer is operated by a 90 h.p. motor mounted at the upper end. For reloading there are two tunnels, a longitudinal one under the trimmer runway and a transverse tunnel from the middle of the runway on the side away from the trimmer. There are two reloaders, one on the trimmer side and one on the other, which move along longitudinal tracks and carry coal on conveyors from the edge of the pile to the longitudinal tunnel in which flight conveyors, one from each end of the yard, carry the coal to the center. Here it is discharged into chutes leading to a bucket conveyor running in the transverse tunnel by which the coal is carried to the edge of the pile and then elevated to the screen tower over the reloading tracks. The two sets of shaking screens have a capacity of 300 tons per hour; this process is so rapid that it is economical to store all sizes of coal indiscriminately instead of making separate piles of different sizes. The power house for supplying electricity for all this machinery can be seen at the right of the photograph taken of the plant when the installation was partially completed. The Dodge Coal Storage Company estimates that the cost of installing their standard system is $1 per ton of storage capacity, and the cost of handling the coal both ways from 4 to 6 cents per ton, but it is believed that in the Ransom plant described above these figures will be reduced.

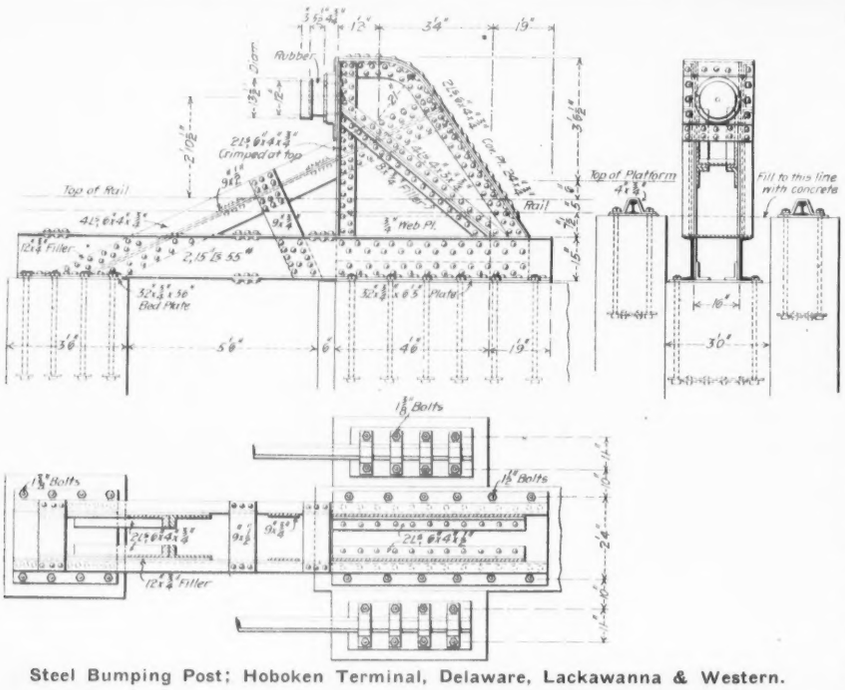
New Bumping Post in the Lackawanna's Hoboken Terminal.

In the reconstruction of the Delaware, Lackawanna & Western passenger terminal at Hoboken a new bumping post has been used, which is illustrated herewith by photographs and drawings. It is built entirely of structural steel shapes and rests on a concrete bed to which it is securely anchored by 20 1½-in. bolts. The bottom ties are 15-in. 55-lb. channels about 15 ft. 6 in. long bedded in concrete laid over the foundation. These provide a stable base, and the upright bracket which carries the rubber bumper block is strongly reinforced with stiffening angles in the direction of the resultant forces under impact. These bumping posts have not as yet been subjected to actual emergency tests, although they have been in place for some time, but it is believed that they will prove unquestionably efficient.





Front and Rear Views of Steel Bumping Post in Hoboken Terminal of the Delaware, Lackawanna & Western.



Steel Bumping Post; Hoboken Terminal, Delaware, Lackawanna & Western.

Disastrous Collision near Woodville, Indiana.

On the morning of November 12 in a butting collision between a westbound passenger train and an eastbound freight train, near Woodville, Ind., on the Baltimore & Ohio, about 50 miles east of Chicago, 47 passengers were killed in the wreck or were burnt to death, and 38 were injured. The wreck took fire at once and the bodies of 45 of the passengers were consumed or were burned beyond recognition. The passenger train was the second section of a regular train, and was occupied by 165 immigrants—Russians, Servians and Poles. The engines, six passenger cars and a dozen freight cars were completely wrecked, and a part of the wreck fell down a bank. Many of the injured passengers were saved from death by fire only by the desperate efforts of the trainmen and the uninjured passengers.

The freight train had received an order to wait at Babcock for the passenger train, but, according to the reports, the engineman believed or assumed that there was only one section of the passenger train, when there were two. He therefore started out after the passage of the first section, and soon met the second train, on a curve, running at full speed. Reports are confused as to whether the engineman had received an erroneous order or had misread a correct order, or was running by time table rules and was deceived by the absence of signals on the first section of the passenger train.

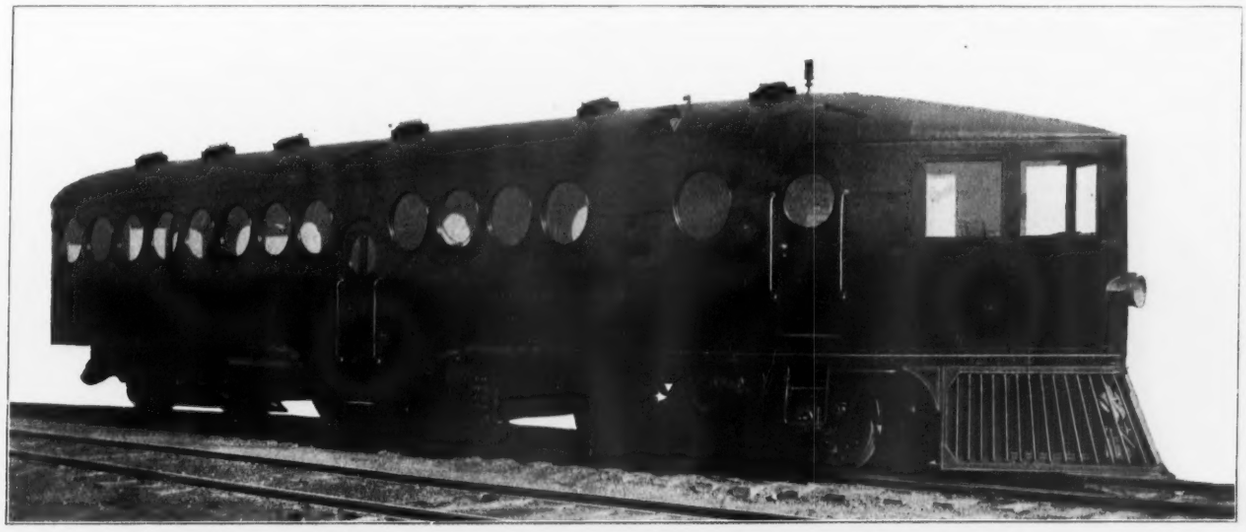
Foreign Railroad Notes.

The Russian authorities have raised the railroad rates on flour and millstuffs 10 per cent. In 1803 the rates on flour were made the same as the grain rates, and this re-establishes a difference. The mills in the west of Russia have called for this change, which helps them to grind for the home and export market. Flour shipments to Finland and to Pacific ports are made at the old rates.

The new Minister of Public Works has issued some new rules affecting the employees of the Prussian State Railroads. Employees who are in debt must not in future be employed where they handle money, nor in storehouses. Generally, employees who have proved unfit for the places they occupy must be transferred after examination to places for which they are fit. Frequent changes are to be avoided, bearing in mind that in important positions practical and experienced employees are indispensable. In making transfers, the convenience of the employees must be regarded and early notice given them.

Union Pacific Motor Car No. 8.

The accompanying photographs of the latest motor car built by the Union Pacific show that in general it is similar to motor car No. 7, illustrated in the *Railroad Gazette* of June 15, 1906. The round windows, which were also a feature of the previous car, have two advantages—they have rubber gasket seats, making them dust and waterproof, and also their use allows stronger construction in the body of the car than when rectangular windows are used. Each side of the car, in fact, consists of two plate girders, resting at the outer ends on the body bolsters and on the inner ends on needle beams at each side of the entrance door. The engine, which has six 10-in. x 12-in. cylinders, can develop 230 h.p. and is much the same as that of car No. 7, except that steel gears are used instead of bronze. The engine drives direct on the axle on the high speed, but it is best to start the engine on a low speed



Union Pacific Motor Car No. 8.

Interior View, Looking from Front of Car; Union Pacific Motor Car No. 8.

through the gears. The car weighs 61,000 lbs. as compared with 58,000 lbs. for No. 7, but it is stated that the weight of subsequent cars can be easily reduced to 55,000 lbs.

Unit Costs of Railroad Building.*

III. BALLAST.

The first two articles of this series gave costs per mile for completed lines in the eastern states and in the southwest. The following data gives the quantities and cost of broken stone ballast per mile for a single-track, double-track and four-track line in the East.

The total cost of one cubic yard of ballast in track is 75.4 cents, made up of the following items:

1 cu. yd. ballast at Rockland Lake	$0.5750
Floatage from Rockland Lake	.0862
Distribution by train	.0346
Labor, putting in track	.0582
Total	$0.7540

This does not include the cost of preparing the track for the ballast, forking over the old ballast and removing the dirt, lifting the track, removing the ties and placing new ties, ready to spread ballast which is handled with Roger cars and ballast plow.

In reballasting a track, there is, of course, a considerable portion of the original ballast which will be used over again, and the cost of forking over the old ballast, lifting the track, removing and replacing ties ready for the new ballast is from 18 to 22 cents per tie, which, assuming the cost as 20 cents per tie, will amount to $562.20 per mile of single-track. A standard cross section provides for the following amounts of ballast per mile:

Single track	2,323 cu. yds.
Double track	4,910 " "
Four track	10,085 " "

The following figures, showing the cost per mile, using the above costs of ballast and adding thereto the labor item of $563.20 per mile of track for preparing track for ballasting, will approximate closely to the actual cost of ballast now in track. It is understood, however, that the full cross section was not put in at one time, but has been done at various times and that in many places there is more stone than required. Assuming the cross section to be standard, the cost is as follows:

	Cu. yds., per mile.	Cost at $0.754 per cu.yd.	Add for labor.	Total per mile.	Per cu. yd.
Single track	2,323	$1,751.54	$563.20	$2,314.74	$0.9964
Double track	4,910	3,702.14	1,126.40	4,828.54	.9843
Four track	10,085	7,604.90	2,252.80	9,856.89	.9774

To ballast a new track according to standard cross section about 15 cents per cubic yard should be added to the cost of ballast ($0.754) to cover cost of lifting track, tamping, surfacing, etc., making a cost per cubic yard of $0.904. Using this price, we obtain the following costs:

	Cu. yds. per mile.	Cost, per cu. yd.	Cost per mile.
Single track	2,323	$0.904	$2,099.99
Double track	4,910	.904	4,438.64
Four track	10,085	.904	9,116.84

The above figures are applicable to tracks carrying the heaviest traffic.

*Previous articles in this series appeared in the *Railroad Gazette*, Sept. 7 and Oct. 26, 1906.

Standard Four-Track Ballasting.

The Beginnings of Unit Statistics.

BY WILLIAM MAHL.*

The history of "statistical units" for which you ask is a subject of particular interest to me. It has engaged my time and thought from the spring of 1860, when I entered the railroad service, to the present day. In the early days of railroad management, when the locomotives and cars of a company did not get off its own rails, and when the expenses were much more simple in their character than in later days, there existed a desire to know something of the cost of the work done, particularly with reference to the "cost of carrying passengers and freight." This desire was in a large measure due to the fact that the managing officers of the railroads in those days either were the engineers under whose charge the roads were built, or had by reason of their education as civil engineers been selected to manage them. The desire for inquiries in regard to cost, natural to minds trained in engineering, prompted inquiries into the relative cost of passenger and of freight service in the early '60s. The annual report of the Louisville & Frankfort and Lexington & Frankfort Railroad Companies (both now part of the Louisville & Nashville), of which Col. Samuel Gill, a graduate of West Point, was Superintendent, for the year ending June 30, 1865, contained the following closing paragraph:

"Allow me to refer you for a very full detail of the year's operations to the various statistical and other tables of the General Ticket and Freight Agent, and of Mr. Mahl, Chief Clerk in the Mechanical and Road Departments. Through Mr. Mahl's assistance we have more thoroughly systematized our accounts, and have distributed, under the head of Freight and Passengers, all expense accounts. We are thus enabled to arrive at the cost of carrying per mile a passenger and ton of freight. The circumstances under which the road has been operated for the last year lessen the value somewhat of the tables, but if continued for a series of years, they will become valuable in arranging your tariff of Freight and Passengers, and in determining the relative economy of operation of these and other roads."

It was my good fortune to be associated with Col. Gill for 16 years, and during that period the annual reports of those companies contained units and interesting data on cost under the then existing conditions. Some of the conditions have since passed away, but for such as still exist the units then observed are in use to-day.

The financial panic of 1873, which extended over a period of

*William Mahl, as is well-known to most readers of the *Railroad Gazette*, is Comptroller of the Southern Pacific, Union Pacific, Oregon Railroad & Navigation Company, Oregon Short Line, Leavenworth, Kansas & Western, and Chicago & Alton—a total of some 12,600 miles of railroads. He was born in Germany in 1843, and began railroad work in 1860, as an apprentice in the Louisville & Nashville shops. Here he was successively draftsman and chief clerk of the mechanical department. In June, 1864, he turned to the department which he was to distinguish, becoming Auditor, and later, Purchasing Agent of the Louisville, Cincinnati & Lexington, now part of the Louisville & Nashville. Thence he went to Texas in 1872 as Auditor and Purchasing Agent of the Texas Pacific. The road was hard hit by the financial panic of 1873, and Mr. Mahl became also the financial agent of the company. In 1874 he returned to his old post on the Louisville, Cincinnati & Lexington, and in 1880 was made General Superintendent of that road. In 1882 he became associated with Collis P. Huntington, and, up to the time of Mr. Huntington's death in 1900, occupied various administrative, financial and accounting positions on the roads which he controlled: The Chesapeake & Ohio; Elizabethtown, Lexington & Big Sandy; Scioto Valley; Kentucky Central; Chesapeake, Ohio & Southwestern; Louisville, New Orleans & Texas; Southern Pacific Company; Mexican International, and Guatemala Central. In 1891, Mr. Mahl became Comptroller of the Southern Pacific and since that time of the other roads mentioned. As head of the accounting department of the Harriman Lines, he has had no small share in bringing about the wonderful results achieved during the past ten years. More than this, by his admirable system of reports, which have made the annual statements of the Union Pacific and Southern Pacific models for all other roads, he has broadened and raised the science and art of railroad accounting. His success in his profession is only equalled by his delightful personality as a man.

six years, enforced economies over the entire country and caused further inquiries into the cost of transportation, and the discussion of units on which these costs should be based or ascertained. The most prominent writer of that period on this subject was Mr. Albert Fink, Vice-President and General Manager of the Louisville & Nashville. The results of his investigations and deductions are published in the 1875 annual reports of that company. Mr. Fink's statement of cost, however, included interest on capital invested, and was, I believe, primarily prepared to meet the then existing clamor for lower rates. The entire subject, however, was dealt with thoroughly by Mr. Fink and his publications bearing on this matter are a part of the railroad classics of this country.

This question of cost and units was also dealt with during that period in an annual report of the Plant System, of which Mr. H. S. Haines was Vice-President, but not to the extent on which it was dealt with by Mr. Fink.

About the year 1878 I became much interested in a scheme of units put into effect by Col. T. M. R. Talcott, then Vice-President and General Manager of the Richmond & Danville. I had formed Col. Talcott's acquaintance about 10 years before, and a common interest in these questions had kept us in touch with each other. I was particularly impressed with Col. Talcott's grouping of the operating expenses under headings which express the controlling factor of the expenses. These groupings are as follows:

FIXED EXPENSES.—Unit—Per mile of main track. Expenses for administration and for maintenance of roadway and structures, which are in the main fixed, such as the general staff, the maintenance of the roadbed, buildings and expenses for maintenance which are in the main affected by the elements and natural decay, and not by the volume of traffic handled.

TERMINAL EXPENSES.—Unit—Per ton of freight and per passenger carried. Expenses for switching, station and terminal service, and all expenses incident to the receiving and delivery of freight and passengers, direct or accessorial.

TRAIN MILEAGE EXPENSES.—Unit—Per locomotive mile in traffic service. Expenses of trainmen, enginemen, casualties and all expenses incident to the running of locomotives.

CAR MILEAGE EXPENSES.—Unit—Per car mile run in traffic service. Expenses incident to the maintenance and running of cars.

GROSS TONNAGE EXPENSES.—Unit—Per gross ton moved. Cost of fuel and water for locomotives, renewal of rails, frogs, switches and all other expenses for maintenance of way which are affected by the weight passing over the rails.

The allotment of the expenses between passenger and freight service was to me of secondary importance only. The cost per ton-mile or per passenger mile expresses only the net result of the expenditures under one or the other grouping, rising or falling with the increase or decrease in such expenditures along such lines of allotment between passenger or freight service as may be in effect for the time.

A careful study of Col. Talcott's principle of grouping convinced me that it was a most excellent arrangement for the control of expenses, and I adopted them and continued to use them wherever I was intrusted with the supervision of earnings and expenses directly or indirectly. It was of signal service to me during the 20 years I was with the late Mr. C. P. Huntington, where my duties were principally to "see what had become of the earnings," as he used to express it.

The direct application of these units, as well as allotment to passenger and freight service, was put into effect on the following properties in the fiscal years indicated: Louisville, Cincinnati & Lexington Railway, 1879, 1880 and 1881; Mr. Huntington's Newport News & Mississippi Valley lines, 1887; Mr. Huntington's Mexican International Railroad, 1896.

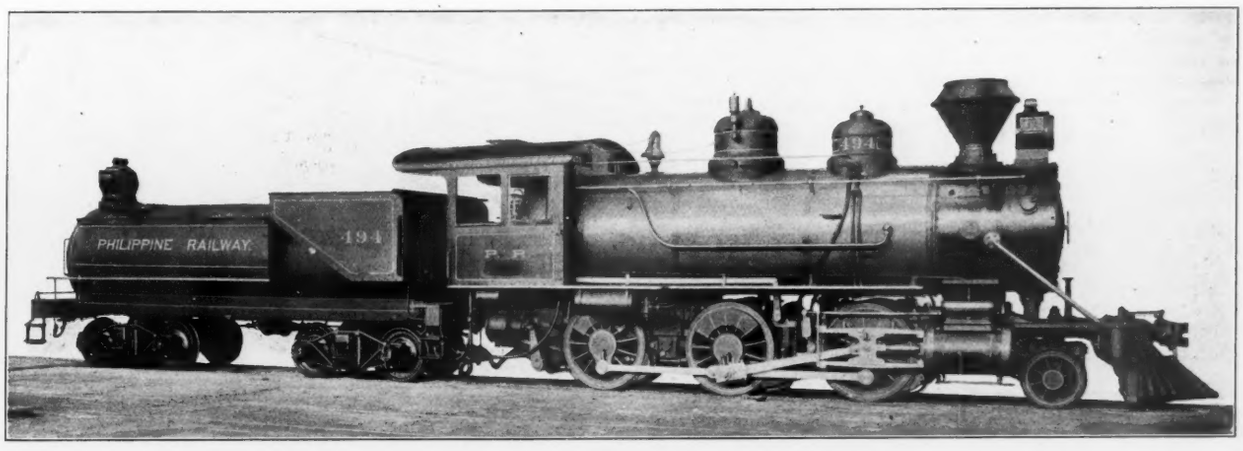
The expenses of the Southern Pacific Company's lines were dealt with similarly up to the year of Mr. Huntington's death, in August, 1900, but with my transfer to other fields of work my inquiries into these matters ceased.

I have written to you on this subject altogether from the standpoint of the officer immediately responsible or charged with the supervision of the expenses, i.e., the cost of service. The units for the general and for the financial public needs are simpler and have been amply provided for in the classification prescribed for the annual reports to the Interstate Commerce Commission. The system of units suggested by Col. Talbott will take care of itself, as will the units of cost per passenger and per ton per mile, as the expenses are controlled by those responsible for them.

It has been no little pleasure to me that interest should at this time be again manifested in a subject which was discussed nearly a generation ago by men of whom the greater part have since passed away. Then it was prompted by economies forced on railroad managers. Now it seems to be prompted by a demand for generally established and accepted units, by which the expenses of railroads, which have now reached enormous sums, can be measured so as to be readily grasped by those who are responsible for them.

Mogul Locomotives for the Philippine Railway.

J. G. White & Co., New York, have recently received from the Baldwin Locomotive Works and shipped for the use of the Philippine Railway now being built by them on the islands of Panay, Negros and Cebu, four mogul (2-6-0) locomotives which are to be used for mixed passenger and freight service. They are built for 3-ft. 6-in. gage and have cylinders 17 in. in diameter by 24 in. stroke, with driving wheels 50 in. in diameter. The leading truck wheels are 28 in. in diameter, steel tired, and carry a load of 14,000 lbs.



Mogul (2-6-0) Locomotive Built for the Philippine Railway by the Baldwin Locomotive Works.

The weight on drivers, engine empty, is 84,000 lbs., and the total weight in working order is 102,000 lbs. The tractive force is about 21,000 lbs., giving a ratio of adhesion of about 4.

The boiler is of the straight top radial stayed type with a barrel 62 in. in diameter and a firebox 96 in. long x 30 in. wide. There are 220 tubes 2 in. in diameter and 10 ft. 6 in. long, which, with the firebox surface, gives a total heating surface of 1,322 sq. ft. The ratio of heating surface to grate area is about 69.

The grate and stack are arranged to burn native lignite coal, which is found in large quantities in the Philippine Islands. A sample of coal taken from the Caridad mine, on the island of Cebu, gave the following proportions: Fixed carbon, 54 per cent.; volatile matter, 35 per cent.; moisture, 9 per cent.; ash, 2 per cent. The stack used for this fuel is a modification of the old diamond stack, which has been used successfully with the lignites west of the Missouri river. The Philippine lignite, however, is of a superior grade, with a large proportion of fixed carbon. Ordinarily, lignites possess less than 50 per cent. of fixed carbon, and this coal might almost be classed as low grade of bituminous. The stacks are similar to the design illustrated in the *Railroad Gazette*, January 20, 1905. An efficient spark arrester is necessary because of the numerous villages en route, composed of native huts having highly inflammable nipa roofs.

The valves are of the Richardson balanced type and are operated by the regular Stephenson link motion. The cab is of steel, but is lined on the sides and roof, and has ventilators in front, sides and roof, as well as a liberal arrangement of doors and windows to adapt it to the warmer climate.

The tender is of the Vanderbilt cylindrical type and has a water capacity of 4,000 gallons; the coal space will carry about eight tons of coal. The frame is made of steel and is carried on chilled cast-iron wheels 33 in. in diameter, the axles being of hammered steel.

The engine and tender are fitted with Westinghouse air-brakes.

and with M. C. B. automatic couplers 34 in. from top of rail to center of coupler. The engine and tender are arranged to work on curves of from 15 to 20 deg.

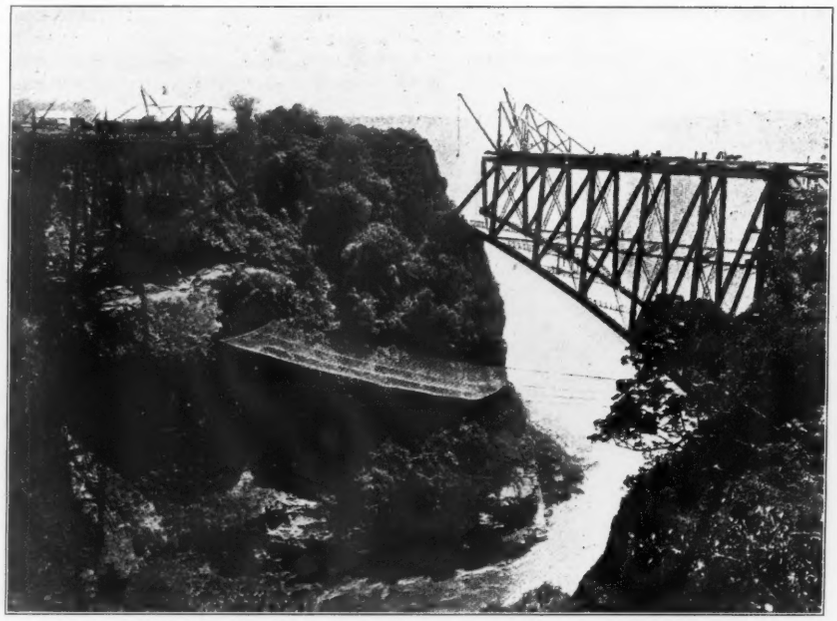
It is estimated that the engines will be able to haul a gross load of 450 to 550 tons up a straight grade of 1½ per cent.

The Zambesi River Bridge.

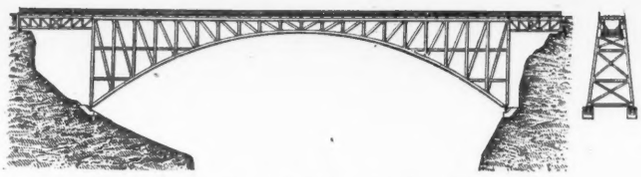
A brief description of the bridge over the Zambesi river at Victoria Falls was published in the *Railroad Gazette* of June 16, 1905. This bridge has now been opened and adds another link to the much discussed Cape-to-Cairo Railway. The structure is interesting, not only as an engineering achievement but also for its location, standing as it does in the heart of what was a few years ago an unknown land. The Zambesi river, after flowing quietly for 750 or 800 miles over the high granite table lands of Central Africa, reaches Victoria Falls, discovered by Livingston in 1885, in latitude 17 deg. 55 min. south and longitude 25 deg. 50 min. east. Here the river forms the boundary between the northwestern and the southern provinces of Rhodesia that make up a portion of the territory ceded to the British South Africa Company.

Above the falls, as shown on the map, the river forms a large lake more than a mile and a quarter broad but narrowing to a trifle more than a mile at the falls, where the water drops about 420 ft. into a confined gulf that extends the whole length of the falls but is not more than 295 ft. wide. Directly in front of the falls is a perpendicular bank, so that the water is in greater turmoil than is usual at the foot of a falls, and the mist is so dense that the water seems to disappear into a bottomless abyss. The outlet of this gulf is a deep gorge about 325 ft. wide at the eastern end of the falls, and through this narrow fissure the water tumbles on towards the Indian ocean, raising a cloud of mist that is said to mount to a height of nearly 1,200 ft., or fully 750 ft. above the top of the banks. This cloud of mist is so high and dense that it can at times be seen 40 miles away. The mist falls again in the form of rain and moistens the ground down to the viaduct, which is about 2,000 ft. below the falls. This produces a luxuriant local vegetation that sets out the banks in striking contrast to the barren soil of the surrounding country. The gorge, with an average depth of 425 ft., stretches on toward the Indian ocean for about 45 miles. At some points it is not more than 165 ft. wide, and it is very crooked.

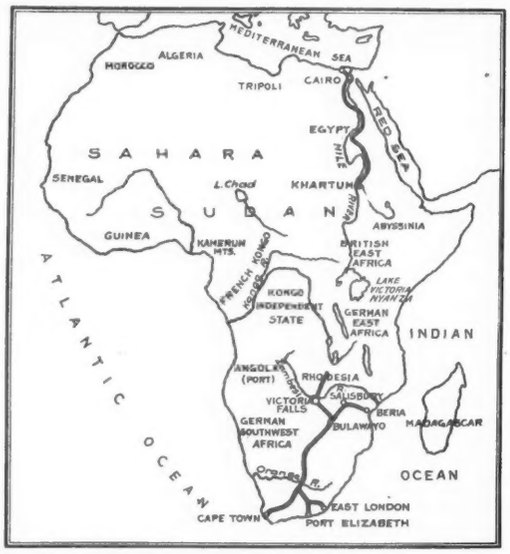
The Victoria Falls of the Zambesi are in every respect the largest in the world; they are 50 per cent. longer than Niagara, which is less than 4,000 ft. long, and they are two and a half times as high. About 2,000 ft. below the falls the Rhodesia Railway recently built across the gorge a steel bridge as a link in the Cape-to-Cairo Railway. Across this bridge rail connection is made direct to the rich copper mines of Broken Hills, 365 miles north of this point and 1,730 miles from the Cape. On the north, rail connection has been made with Khartum, 1,335 miles, whence the route will be by way of the Nile and Lakes Albert Nyanza and Tanganyaka. The bridge just built is, as shown in the accompanying drawing, a parabolic arch with hinged skew backs at the abutments and with both vertical and diagonal braces to carry the upper chord. The arch has a clear span of 500 ft. and a rise of 90 ft., or one in five and a half. The center span is connected to the banks by two shore spans of 87.5 ft. and 62.5 ft. on the south and north sides respectively, so that the total length of the viaduct is 650 ft. The depth of the arch span at the center is 15 ft. The width of the bridge is 53½ ft. and the top of rails are 400 ft. above the water. The structure is designed to carry two tracks, but only one has yet been laid. The abutments are concrete, set 295 ft. above the river in basaltic rock. The total weight of metal in the viaduct is about 1,650 gross tons. In many respects this bridge resembles that of the Grand Trunk at Niagara Falls; the span of the latter is, however, about 50 ft. longer. The photographs show views of the structure when partly built and when ready for the rails. The erection of such a bridge in such a place was naturally a task requiring great skill and care. Work was carried on from both sides at once. To sustain these two half spans without falsework, while being erected and up to the



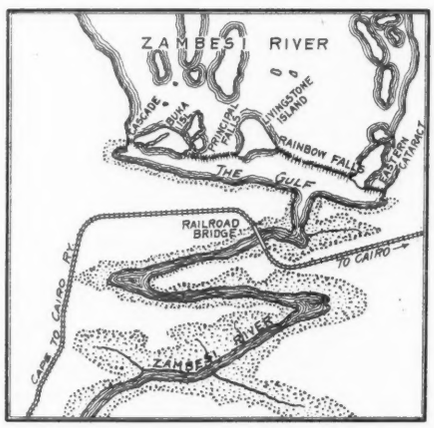
Erection of Zambesi River Bridge.



Side Elevation and Cross Section, Zambesi River Bridge.



Cape-to-Cairo Railway.



Victoria Falls of the Zambesi River.

moment of the closing of the arch, they were held by steel cables, firmly anchored in solid rock. At the time of the closing of the arch the stress on these cables for each half span was about 800 tons; so the greatest precautions had to be taken to insure the solidity of this temporary anchorage, which was removed as soon as the two ends were brought together. This method of simultaneous construction from both banks necessitated carrying all the parts for the northern half of the span across the gorge. This preliminary and delicate work was done on a cable stretched across the gorge in the plane of the viaduct itself, and extending from steel towers erected on either bank set 870 ft. apart. An electric telpher, weighing five tons and of ten tons capacity, was run on this cable and used to carry the structural material across. This cable was also used for carrying over everything needed in the building

Zambesi River Bridge; Completed Span.

of the extension of the road to the north, so that this section might be opened as soon as the viaduct was finished. The 2,000 tons of bridge material, and accessories, were all brought from England.

Mr. Hill on Railroad Expansion and Reciprocity With Canada.

Mr. James J. Hill, President of the Great Northern, delivered an address at the annual dinner of the Merchants' Club of Chicago, November 10, on the subject, "Canada and Reciprocity." He also said some things regarding the present congestion of traffic and the serious transportation problems of the future foreshadowed by the present situation that were not in his prepared address and in the course of which he expressed himself in strong terms regarding the present trend toward government restriction of railroad management. The text of these remarks was an editorial which had appeared in the *Chicago Tribune*, showing the relative increase in 10 years in the country's railroad mileage, number of cars and locomotives, and the ton-miles of freight traffic, based on the reports of the Interstate Commerce Commission. The editorial quotes Mr. Hill as saying:

"I have noticed that from 1895 to 1905—ten years—the growth in ton-mileage was 110 per cent. The growth in the mileage of railroads to handle that traffic was 20 per cent. There's where you stand to-day—you can see it in that brief comparison. There's where the whole country stands. The traffic of the country is congested beyond imagination. The commerce of the country is paralyzed, and, continued, it means slow death.

"More cars? Yes, we need more cars, but we need also cars of greater capacity, heavier trains, and more miles of railroad to haul them over. In ten years the railroads of the country expanded 20 per cent. for the handling of a business that increased 110 per cent. Suppose you are able in the near future to increase that expansion 50 per cent.? That will still leave 40 per cent. a year of the business without any facilities for taking care of it.

"It is estimated that from 115,000 to 120,000 miles of track must be built at once to take care of this immense business. But to build that amount will cost as much as the civil war cost, at least. It will cost from $4,000,000,000 to $5,000,000,000. A thousand millions of dollars a year for five years will scarcely suffice. Why, there is not money enough nor rails enough in all the world to do this thing. And if the rails were piled up ready for the undertaking, and if the money were in bank to-day, it would be impossible to get the labor with which to do it.

"I tell you there is no question since the civil war of half the consequence of this one. Why, you can't go out and contract with any railroad in this country to move 500 cars of freight from here to New York in 30 days. And the railroad could not deliver if it should contract to do it.

"The great cry is that there are not cars enough. The trouble is that you can't put cars on the track and get half the movement out of them that you could 10 years ago. Statistics show that freight cars running from 12 to 15 miles an hour average a movement of 25 miles in 24 hours. Think of it, only two hours a day in operation. Is there any business in the world that can sustain itself when its equipment is in use only one-twelfth of the time?

"There is not money enough available to bring relief to this situation under the conditions existing. You may be able to see a way out, but I can't. Are men going to invest their money in railroads as long as railroads are considered outlaws? The fact is, the railroad has not been getting justice in this country. Why, in the recent campaign we beheld the spectacle of two great political parties preaching the doctrine of the operation of the railroads by the Government. The Federal Government is to run the main lines—they're the only ones that make any money nowadays—and the private investors can have the branch lines, there being no profit in them. Is that the way to get men to put more money into the country's railroads? Is this the way to get more railroad mileage so that the country's freight can be moved? It is time to call a halt in this treatment of the railroad. Why, I challenge you to point out a road that has not failed at some point in its career. Most of them have been organized, have had their capital wiped out, and have gone into the hands of receivers. It's been a fad, and a costly fad, to build railroads."

CANADA AND RECIPROCITY.

Mr. Hill's address on Canadian commerce and reciprocity, in which he advocated the establishment of reciprocal trade relations with that government as soon as possible, was in large part as follows:

"By the middle of the present century this country will have a population of more than 200,000,000. . . . There is no more important work for the general government than the early construction of a canal from St. Louis to New Orleans, with a depth of at least 15 ft. There is a crying need for such a canal now, and, bearing in mind what has been said about the general widespread want of railroad transportation, the sooner the work is commenced the better for the country. . . .

"Let us drop political theories and all the prejudices and preconceptions trailing after them, and look at this situation as a plain business problem. North of us lies a country of enormous possibilities for development, inhabited by between 5,000,000 and 6,000,000 people. It has 19,000 miles of railroads, with several other great projects actually under way. It has a foreign trade of only a little short of $500,000,000 a year. Its capital invested in manufactures is over $400,000,000, and the value of the annual product is $480,000,000. Its people have deposited in their savings banks $82,000,000.

"It has achieved this growth without outside aid, exactly as the United States has grown, by virtue of its inheritance of fertile land, rich mines, and noble forests, and by the industry and integrity of its people. And it is only at the beginning of its development. Its unworked resources are immense. There is land enough in Canada, if thoroughly tilled, to feed every mouth in Europe. There are more than 250,000 square miles in each of two northwest provinces, and there are 250,000,000 acres of timbered lands in the Dominion. This is a neighbor to be taken note of.

"We come now to the plain question, amazingly simple when severed from politics, why this country and our own should not be commercially as one. We have seen what the great central valley of this country is to the nation. Fancy it possible to have that most precious national possession in some way duplicated. How the national imagination would exult in the addition to our business and in the new prosperity to come from the new heritage.

"Yet that is substantially what unhampered trade relations with Canada would mean. The certain fate and fortune of this adjoining country, so similar in physical characteristics, so identical in language, customs, and usages of trade, is to be developed by a series of common agencies working in uniformity. It may require years; you or others may reap the harvest of gain. But there is an integrity, as it may be called, a oneness and a plan in American material development as indivisible as the surface of the land reaching as far north as the limit of human settlement. The same natural conditions that fixed Chicago here and fostered its amazing growth are at work, in other ways, to dictate American commercial unity. It may be postponed to the certain loss of both parties. It cannot be ultimately defeated. . . .

"Hold political considerations aside, consult the interest of the whole community, and determine this matter of business by business principles. The conclusive argument for reciprocity with Canada always has been and must be the experience of the several American states. Had it not been prohibited by the constitution, each state of the union would speedily have levied a duty on all commerce crossing its boundary. Even with the enlightenment of our own past behind us it is most probable that if this prohibition were removed, not many years would pass without some such restrictive legislation by certain of the states. Yet all acknowledge at this moment that one great factor in the development of the United States and its wonderful progress has been the commercial elimination of state lines. Unrestricted trade between the states has favored all of them.

"Now, whether this argument does or does not apply to our relations with European countries, different in history, in trade customs, and in material circumstances, it does apply to our northern neighbor, so nearly allied to us in natural conditions and in mode of growth. Canada is merely a portion of our

own western country, cut off from us by the accident of original occupation and subsequent diplomatic agreement. . . . The Dominion will, in any event and under any system, be opened up and highly developed. With its vacant spaces occupied and all its industries humming at the demand of new population, why should not its business and ours be transacted by agencies that work with the highest efficiency and at the lowest cost?

"Already demand and supply have forced a relaxation of tariff rivalries, which permits the wheat of Canada to be brought into the United States, milled in bond, and the flour exported without payment of duty. Wherein could any farmer suffer by the completer opening of a market already thus extended, since the price of this grain in any event is fixed by the surplus for export and the quotations of foreign markets? In 10 or 15 years, according to present indications, the United States will need every bushel of its wheat product at home. Would it then be disadvantageous for us to share in the products of the fields of Manitoba, Alberta, and Saskatchewan?

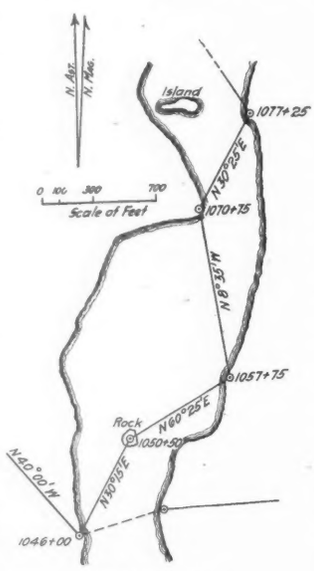
"Canada has already one transcontinental railroad system. Others will soon be added. It has a system of waterways which is justly its pride, On this it has spent nearly $100,000,000. The St. Lawrence system of canals furnishes 43 miles of artificial channel to reinforce river and lake. The Welland Canal completes the chain. The most ambitious project, and one in which every lake city has a stake, is the proposed canal from Lake Huron to the St. Lawrence River direct. Engineers have examined the scheme and pronounced it feasible. This ship canal would extend from Georgian Bay by way of Lake Nipissing and the Mattawa and Ottawa rivers, reducing the distance from Georgian Bay to Montreal to 430 miles. This is nearly 300 miles less than the present route by way of Lake Erie and the St. Lawrence River. . . .

"Canada no longer comes as a suppliant. There has been increasing irritation toward our attitude, and already the fact that our average tariff on dutiable articles coming from the Dominion to us is 49.83 per cent., while that levied by Canada on dutiable goods coming from the United States is 24.83 per cent., causes comment and suggests reprisals. The beginning of all reform or progress in public policies in a republic is the creation of an intelligent public opinion. To this work the friends of reciprocity in the United States should address themselves. Already the people of New England are clamoring for a more generour trade relation. Along the whole tier of States adjoining the Canadian boundary, covering precisely the territory where reciprocity would be most bitterly opposed if this country had aught to fear, it is in popular favor. The lack now is of intelligent leadership, of a strong centre of agitation, of a community powerful enough to make itself heard and felt."

Traversing Lakes and Rivers With the Stadia.

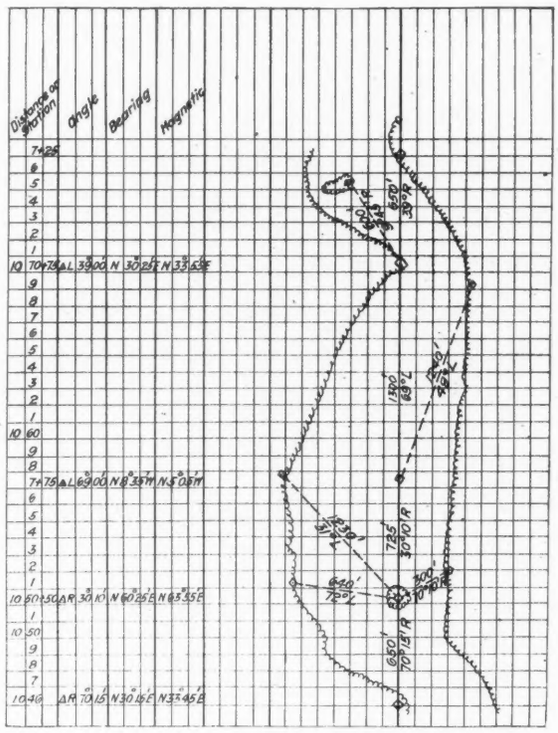
BY J. A. MACDONALD, C. E.

In our work on the surveys for the National Transcontinental Railway, the eastern end of the Grand Trunk Pacific, there has been a great deal of stadia work to do, mostly in the transversing of lakes. In the country through which the road goes few white men have ever trod, since it lies over a 100 miles north of the Canadian Pacific, in the wilds of northern Ontario, an unexplored territory. In this country no geographer has ever taken notes, so that besides mapping the route of the projected railroad a map of the country adjacent had also to be made. This made the topography work extensive. The country is a continual chain of lakes, which, however, is an advantage in that portages are usually short, and as all packing and moving of camp effects and provisions has to be done by human packers the existence of frequent bodies of water makes it possible to use canoes most of the time and saves much carrying on men's shoulders. Few of the portages through the country are more than a mile long, and many of them much less. These portages are usually between small lakes, not more than six or eight miles long, and some less than a mile long.



Completed Map.

In passing through this country with the survey we usually followed up those lakes which we passed to their heads, making a traverse with the stadia. This work could be done very rapidly, often making eight or ten miles a day. In this way the lakes, rivers, etc., could be mapped as well as the adjacent country for many miles on each side of the line. Also, in tying on to the next party we often used the stadia, by traversing up a lake and following its outlet to the next lake, and so on until we struck the other party's line. In this stadia work an ordinary 14-ft. leveling rod was used. By taking half the distance between the stadia hairs, that is, the distance between the middle hair and the one adjacent, it was possible to read 2,800 ft. at one shot. In some cases by placing the rod on a high stump of a tree and measuring from the top of the rod downwards on the stump, we took sights 4,500 ft. distant. By a little ingenuity, and using a bright target, it is possible to take very long sights. I have seen sights over a mile taken on the water, though 4,500 ft. was the longest sight taken by the writer. In all cases we read the rod from the top, using half the stadia hair, except for short distances of from 300 to 700 ft., when the whole distance between the stadia hairs was used. For a target we used, in most cases, a field book, bound in brown leather. Sometimes to brighten it, the rodman wrapped a white handkerchief around the book so that it could be seen by the transitman more clearly.



Specimen Page from Field Note Book.

The method of traversing a lake is shown by the accompanying drawings. The first shows the notes in the field book, taken at the time, and also the rough sketch; and the second shows the completed plan of a lake, on the usual scale, as placed on the map, with bearings, stations, etc., marked thereon. Two canoes were always required, one for the rodman, picketman and two axemen, and the other for the transitman, stakeman and one or two canoe men. Starting on the railroad line at the bank of the lake, station 1,046, a backsight is taken, and the angle turned, in this case, to the picket held on the rock, at station 1,050 + 50, the angle being read which, in this case, was right, 70 deg. 15 min. This was marked in the proper place in the field book. Next the rod was held on the hub and the distance, 650 ft., read, which was also marked on the red line, as shown, on the right-hand page of the field book, and afterwards placed in the proper column on the left-hand page, as shown. This, of course, could not usually be obtained, except for short distances, until the transit party came up in the canoe to the rod party, which, here, was on the rock. Before the transitman left his station, or while going from one station to the other, a sketch was made on the page of the field book, which being ruled into squares of 100 ft., made it a simple matter to draw fairly well to scale. In drawing the sketch the center red line of the field book is supposed to be the line run, no matter how many angles are made. On reaching the rock and getting the rod reading from the targetman, the rod party proceeds to the next station, affording a good sight, which, here, was on the opposite side of the lake, station 1,057 + 75. The transit man, after taking his backsight and tilting the telescope forward, gets the deflection angle of this new station in the same way as the first, and, similarly, the rod-reading. Several side shots had to be taken here, so the rod party proceeds to two different points on the left bank of the lake, and no one point on the right bank; the readings and angles of these are taken with the rod alone, no hub being considered necessary at those side points, and can, therefore, be thus taken more rapidly. A back picket having been driven the transit party proceeds to the hub just driven at station 1,057 + 75, and sets up, while the rod party proceeds to the next

favorable point, 1,300 ft. away, to station 1,070 + 75. A side shot to the right, 1,240 ft., is also here taken, and so the work proceeds. While the transitman is going from one station to the other, in the canoe, he has time to make the sketch. With some experience in this work one can tell distance on water very accurately. He will note the points, coves, small islands, rocks, etc., and place them in the proper place in his sketch, and the sketch being drawn on the same scale as the general map, viz., 400 ft. to 1 in., can be taken off the field book without much trouble. From station 1,070 + 75 a side shot was taken on the small island shown so as to properly locate it. These side shots are, of course, not shown on the map. They are necessary only for making an accurate sketch and map. The transitman, while waiting, has also usually time to calculate his bearings. The railroad line, at the starting point, had a bearing of N. 40 deg. 00 min. W., or S. 40 deg. 00 min. E., as you like. The angle turned was R. 70 deg. 15 min., which made the bearing of the first stadia station N. 30 deg. 15 min. E. Proceeding, the next angle turned was R. 30 deg. 10 min., which made the bearing of the next station N. 60 deg. 25 min. E., and so on. In the sketch, from actual practice shown, the magnetic variation of the needle was 3 deg. 30 min. east of astronomical, which made the magnetic bearing of the first course N. 33 deg. 45 min. E., as shown in the proper column in the field book.

The Eastern Bolivian Railroad.

An engineer attaché of the German Minister in Buenos Ayres reports the conclusion of a contract between the government of Bolivia and an Argentine corporation for building the Eastern Bolivian Railroad, which will give Bolivia an outlet to the Atlantic. By far the larger part of its territory lies on the eastern side of the Cordilleras and is a tropical wilderness. Most of it is drained by the upper tributaries of the Amazon, while the southeastern part drains through the Paraguay into the La Plata. The railroad is to run from the Paraguay, at a point not yet determined, westward to Santa Cruz de la Sierra, just north of latitude 18 S., which is just on the eastern edge of the mountains. By an unusual provision of the treaty determining the boundary between Brazil and Bolivia, the right bank, and not the middle of the stream, of the Paraguay is the boundary; and on this account the railroad is to begin at a harbor in a lake or lagoon in Bolivian territory and be connected with the river by a canal, which need be but a very short one, as this part of the territory is to a great extent overflowed. One of three points is likely to be this eastern terminus: Bahia Negra, or Pacheco, the southernmost, is about 25 miles south of the twentieth parallel; Corumba, about 100 miles further north, and Gaiba, about 25 miles north of the eighteenth parallel and about 400 miles due east of Santa Cruz de la Sierra.

The country in this part of Bolivia is almost uninhabited, except by wild Indians, and at present has no practicable outlet. Among those promoting the enterprise in Buenos Ayres are the firms and persons engaged in the "quebracho" business, quebracho being the most durable of woods and a source of tannin, hitherto obtained chiefly in the "Gran Chaco" of Argentina and in Paraguay. The Bolivian government grants the railroad company about 12,000,000 acres of land, and guarantees the 5 per cent. interest on the cost of construction up to $16,000 per mile, which has covered the cost of other narrow-gage roads in the Chaco depression. The members of the syndicate who have undertaken the work are among the leading capitalists of Argentina, and the enterprise seems to have a solid basis.

The Ventilation of the Kaiser Wilhelm Tunnel.

The *Ann. f. Gew. u. Bauweisen*, of August 15, 1906, contains the following account of the ventilation of the Kaiser Wilhelm tunnel on the line between Coblenz and Trier, which is the longest in the German Empire, 13,776 ft. from portal to portal. It was opened to traffic in 1879 and almost from the beginning gave trouble from poor ventilation which was accomplished by natural draft. It is a double track tunnel with a full circular arch of 13.64 ft. radius and is lined throughout with rubble masonry. There is a difference of 45.85 ft. between the end near Eller and the end near Cochem. With the rapid increase in the traffic through the tunnel between 1895 and 1900 the air in the tunnel became so foul as to seriously inconvenience the track gangs working in the tunnel and passengers on trains passing through it. About 1900 plans were made for providing positive ventilation on the Taccardo system which had been successfully applied in the St. Gotthard tunnel. This system, it will be remembered, is based on the principle of the injector. An annular tuyere is built in the portal and a blast of air from fans is forced into the tunnel through it. The entering air entrains the dead air near the portal and creates a draft through the large bore inside the annular tuyere.

In designing the plant for the Kaiser Wilhelm tunnel the annular tuyere was made with an adjustable opening, the object being to determine by experiment after the completion of the plant the width of discharge opening of the tuyere and the angle of inclination of its central plane to the axis of the tunnel which would produce the maximum current of air flowing through the tunnel with the minimum expenditure of power at the fans. The plant was erected at the north end of the tunnel which has the highest elevation. Two fans 16 ft. 5 in. in diameter were installed, either one of which is sufficient capacity to furnish the required amount of air. These fans are outside of the power house, the connecting shafts passing through the power house wall. They are each direct connected to a two-cycle Koerting gas engine which is supplied with gas from a suction gas plant in an adjoining building. The gas producers are adopted to use either anthracite coal or coke. Two small gas engine generator units also supplied from these producers are installed in the engine room to furnish electric light for the Cochem station.

After the plant was in working order a series of tests were made to determine the most economical dimensions and form of the tuyere. These tests showed that the mean angle of inclination of the tuyere to the axis of the tunnel should be 29 deg. and the width of the discharge opening 1 ft. 3¾ in. All of the adjustable parts of the tuyere and of the discharge deflectors were then securely riveted in this position and the plant has since that time been worked without change. The following table gives the results of some of the tests made to establish the most economical width ot discharge opening:

No. of test.	Revs. of fan.	Effective H.P.	Velocity of air in m. per minute. In the tuyere: Right.	Left.	Top.	Bottom.	In the tunnel at: Cochem.	Eller.	Air pressure in mm. of water column. At the fan.	In the air chamber. Right.	Left.	In the tuyere. Right.	Left.
Width of discharge opening 0.60 m.													
1.	90	92.2	424	618	550	685	80	65	5	20	8	10	5
2.	105	142.8	540	800	612	685	80	65	10	22	10	15	10
3.	120	216.5	560	900	702	741	143	105	16	25	12	15	10
Width of discharge opening 0.30 m.													
9.	90	85	635	780	605	750	124	115	5	20	11	18	10
10.	105	150	705	935	725	845	130	160	9	25	20	25	15
11.	120	210	855	915	830	865	136	150	10	35	25	30	18
Width of discharge opening 0.40 m.													
30.	88	55	921	747	559	921	126	120	7	11	13	11	15
31.	103	90	1,085	878	633	1,104	181	105	9	14	17	16	19
32.	116	130	1,207	1,007	742	1,253	202	175	12	18	20	22	25

Some other interesting tests were made. A southwest wind produced an air current through the tunnel in the reversed direction when the fans were stopped; both fans were then started at 60 r.p.m. and almost immediately reversed the direction of the current. In a short time the velocity of the reversed current at the opposite end of the tunnel was 453 ft. per minute. An analysis of samples of air from the tunnel taken October 17, 1905, under unfavorable conditions gave at the center of the tunnel 11 parts of carbonic acid in 10,000 parts of air, and at a point in the tunnel a short distance from the end farthest from the fans 17 parts in 10,000 parts of air. This is about one-quarter of the quantity of carbonic acid contained in the air before the installation of fans.

A short distance from each end of the tunnel a gage is mounted on the wall which indicates automatically on a dial in the engine room the velocity of the air at these points, thus enabling the engineer in charge to regulate the speed of the fans and to maintain the desired velocity of the current.

Old Styles of Car Decoration.

BY C. H. CARUTHERS.

Standing beside a Pullman parlor car in the Waverly station in Edinburgh one September morning in 1878, the writer asked the quiet-mannered Scotch guard his opinion of the coach. "Aye, they're graund; but I dinna lak thon paintin'—it's too lak chaney cup," he replied.

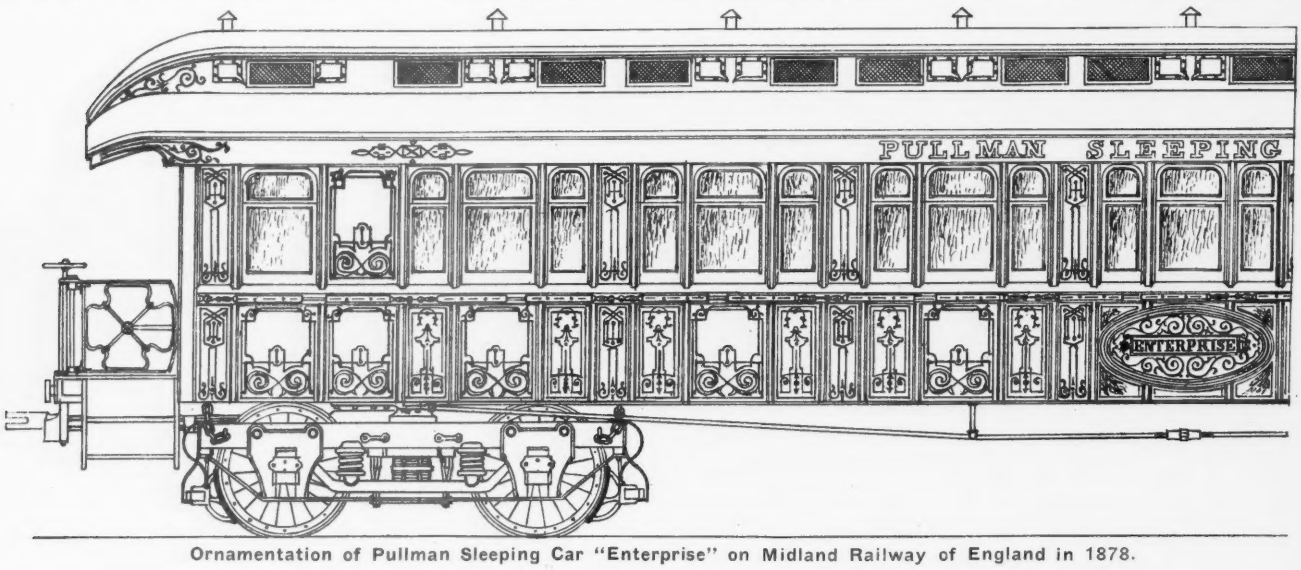
The drawing of another Pullman of exactly similar design, which was then in service on the Midland Railway (England), which accompanies this article, will convey to the younger railroad men of to-day not only an idea of that particular coach, but of the ornamentation of all Pullman cars of that time, as the design is substantially the standard then followed by the company on all its equipment.

This design was the highest point attained by a growth which increased gradually with each year from the building of the first Pullman. This gradation, although slightly accentuated by the efforts in the same direction of the rival Central Transportation Company, in the early seventies, was withal so conservative in each successive step that one unconsciously grew to regard it as the natural accompaniment of a Pullman, and would have been no more surprised to have seen an autumnal landscape without its brilliant woodlands and scarlet ivies, than to have seen these cars without their arabesques of gold and shadings of scarlet, maroon and other brilliant tints.

The reply of the Scotch guard lingered unaccountably in my memory, and as I glanced down along the train the small, neat stripes of gold and the chaste monogram, "MR," which formed the

only ornamentations on the rich vine-colored bodies of the long "double-bogie" carriages of the Midland Railway, appeared in a new aspect and so impressed themselves upon my mind that on again looking at the Pullman, its florid decorations began to stand out in their true light and the comparison to a china cup became more relevant, especially if the cup was of the type of "art" usually seen in the show windows of the average department store.

By reference to the drawing it will be observed that each panel, both below the belt rail and between it and the cornice board, bears an intricate design in no way connected with that in the adjoining panel. The oval panel at the center is also filled with tracery surrounding the rectangular lines around the name. Tracery also appears on the cornice board, and, in fact, on almost every spot where a design could possibly be placed. The body of the car was painted the standard Pullman color, the tracery as well as all lines, lettering, etc., was in gold leaf, and this was in turn shaded with



Ornamentation of Pullman Sleeping Car "Enterprise" on Midland Railway of England in 1878.

scarlets, maroons, blues, greens and black. The rectangular space within the oval panel at the center, which carried the name, was painted in vermilion and the letters were shaded in darker tints. Even the narrow strip covering the outer part of the belt rail was elaborately decorated, and here colors ran riot in an apparent effort to outdo the design of gold, and yet conceal themselves behind its glitter.

The development of a craze for the æsthetic, perhaps accompanied by a desire to reduce the cost of construction and maintenance, must have opened the eyes of some of the officers of the Pullman Company about the same time, as very soon afterward all repainted cars had the design widened to cover two panels wherever possible, the moulded panel at the center was much plainer, and the greater part of the decorations on the belt rail was omitted.

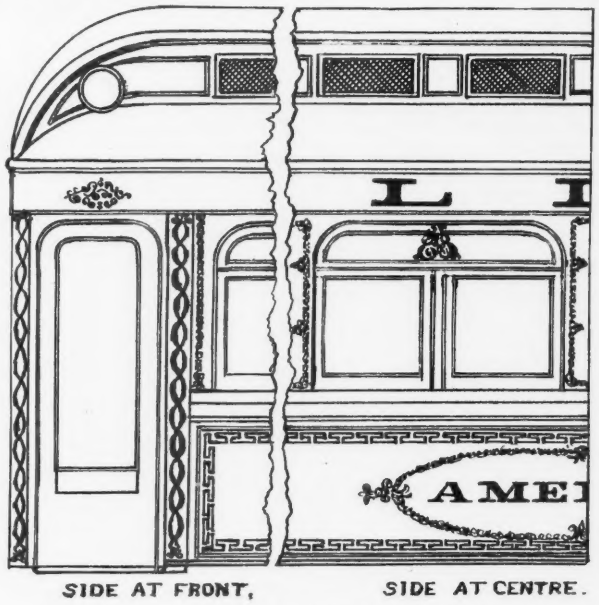
Still later, when narrow, beaded sheathing replaced the wider boards with strips over the joints, the entire length of the part of the car below the windows was divided by lines of gold leaf into three panels of uniform length, and the central one contained the name and type of car on a black ground surrounded by gold lines and neat arabesques.

Still later this part of the car became one panel as far as the painting, etc., was concerned, and the name only appeared in the center, surrounded by an oval of gold. This oval was about the shape and size of the old moulded panel shown on the Enterprise.

It is just possible that doing away with a visible division at the belt rail, and carrying the sheathing from the bottom up to the lower edge of the cornice board, wherever possible, led to the present simple decoration of narrow stripes of gold leaf around the edges of the window and door frames, a long, broad band also of gold leaf, at the bottom of the sheathing, the name "Pullman" on the cornice board, and the name of the car at the center, midway between the windows and the bottom, both being of gold without any embellishment, and of a simple form of light and heavy line letters.

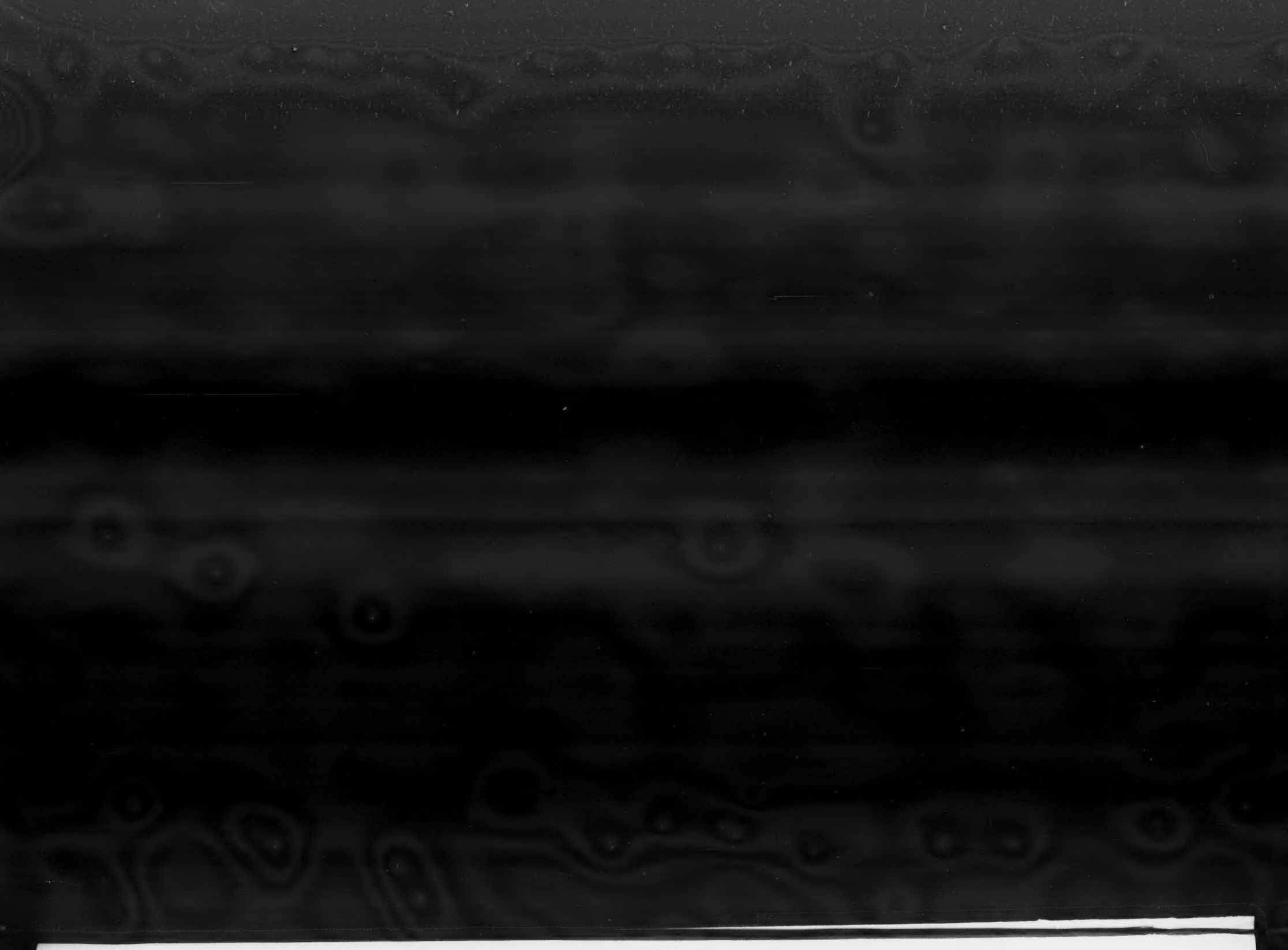
The cornice boards of the early Pullman cars contained the words, "Pullman Sleeping Car," in metallic, silver-plated letters on a black ground, and if I am not greatly mistaken, a number were marked during the late sixties, with the inscription, "Pullman Silver Palace Sleeping Car." At that time many, if not all, of the sleepers had the front of the upper berths covered with the same material as used for head-linings, and painted in the same florid style as the head-linings of that time.

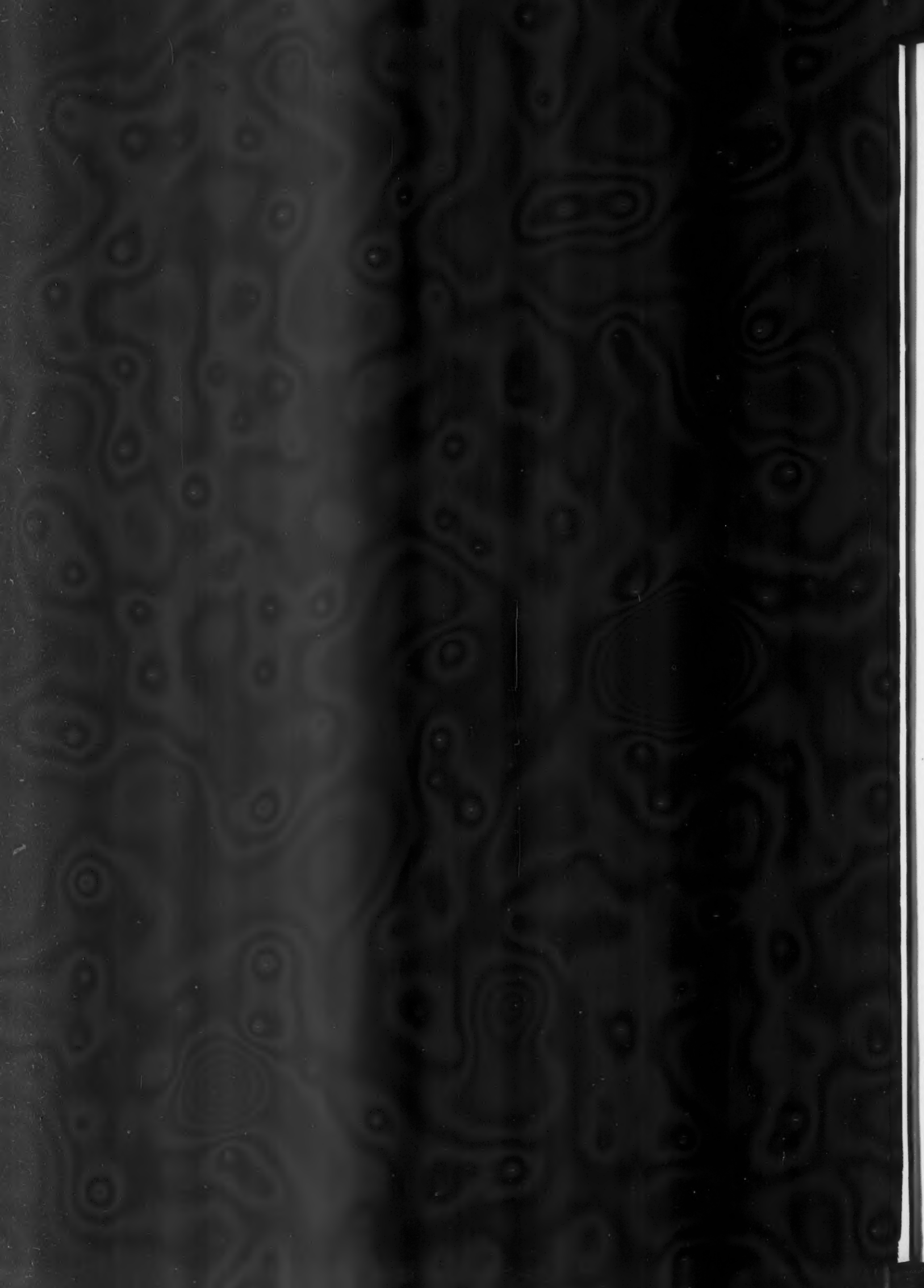
The company has rigidly adhered to the present Pullman standard color wherever possible since 1869, although at that time one of the first dining cars, the "Young America," was painted a rich wine color. Probably the first marked deviation from the standard color was on the cars run by the Pennsylvania on its "Royal Red" trains in 1893, and on those used by the Chesapeake & Ohio on its "F. F. V.," Limited Express. It is said that the Pullman Company objected vigorously to this innovation, however. In 1898 it turned out a lot of cars for the Pennsylvania Limited and the Congressional Limited, which were soon known to the trainmen as "Dolly Vardens," and will doubtless be remembered by many railroad men, as they have been but a short time retired from these trains. From the bottom to the belt rail, dark green was used, cream color covered the belt rail and solid work between the windows, and the cornice board was Tuscan red. The whole was ornamented with striping and lettering in gold leaf. The Baltimore & Ohio also used a few Pullmans on their Royal Blue Line trains between New York and Washington, painted royal blue. At present all Pullmans running in regular service over the Pennsylvania Lines are painted in the Tuscan red used by that company with P. R. R. standard striping.



Ornamentation of Pullman Cars in 1893.

During a recent trip through Pennsylvania, I ran across an old Pullman which had been sold to a party conducting some sort of a theatrical enterprise. It had evidently been one of the highly decorated class at one time, but its purchaser perhaps thought to improve on this. He probably believes he has succeeded. From the bottom of the car to the belt rail it was painted a pale cream color Ultra-marine blue "ornamented" the panels and formed a broad stripe at the floor line. The cornice board was a dull Venetian red. A few "splotches" of blue were scattered around at random, and the word, "Private" was in yellow letters on the doors. The "chaney cup" had been superseded by the negro quarters of a Southern town!





GENERAL NEWS SECTION

NOTES.

It is announced in Springfield, Ill., that two sleeping cars have been ordered for use on the Illinois Traction (Electric) lines between Decatur and St. Louis.

The New York State Superintendent of Public Works announces that the Erie and other canals of the state will be closed November 28, unless sooner closed by ice.

The Merchants' & Travelers' Association, of Philadelphia, has established a Freight Complaint Bureau for the use of its members in collecting claims for loss and damage.

At Sioux Falls, S. Dak., November 7, the United States Court decided that express companies in that state are common carriers, and, therefore, subject to the authority of the State Railroad Commission.

Near Carlin, Nev., on the night of Nov. 11 a passenger train of the Southern Pacific was stopped by robbers and about $1,000 worth of property was taken from the passengers.

Near Slater, Mo., on the night of November 8 a passenger train of the Chicago & Alton was stopped by robbers and about $500 worth of jewelry and other valuables was taken from the passengers in a sleeping car.

The Wisconsin State Railroad Commission has issued a decision sustaining the right of the Wisconsin Central Railroad to carry at half the regular rates machinery and materials to be used in a new factory to be built on the line of the road.

Vice-President Thayer, of the Pennsylvania, denies the reports, published in Wall Street and elsewhere, that the company contemplates an advance in freight rates to make up for the increased expenses due to the raising of the pay of the employees.

On four trains of the Pennsylvania Railroad which have dining cars, orders for meals, with seats reserved at a fixed hour, are to be taken about an hour before meal time. This is an experiment, to be tried with a view to removing the annoyance of crowded tables.

In a large new freight house to be built by the Louisville & Nashville in Atlanta, Ga., to be ready for occupancy next spring, there will be large areas to be let to merchants and manufacturers. The building is to be five stories high, with eight large elevators.

Under a contract which has recently been made between the Mexican Central Railroad and the Government of Mexico a certain percentage of trainmen and office clerks of the road must be Mexicans. The amount of the percentage has not been made public, but it is understood to be 25.

At Pittsburg, November 9, the Grand Jury in the Federal Court indicted F. L. Emmet, James Dunn and Charles L. Close for conspiracy to defraud the government in furnishing 10,000 defective boiler tubes for war vessels. The three men named were employed in the Greenville shops of the Shelby Tube Company.

The Second Assistant Postmaster-General has ordered an investigation into mail bag catching and delivering apparatus with a view to selecting the best appliances of this kind for use in connection with trains moving at high speed. The commission to make the investigation is headed by C. M. Vickery, Superintendent of Railway Mail Service, Washington, D. C.

A press despatch from Columbus, Ohio, says that the Pennsylvania Lines West of Pittsburg will establish a school in which to train men for service as conductors of dining cars. Hitherto the company has sought men who have had experience in clubs or hotels, but has concluded that better service will be obtained by educating men who have seen service on the trains of the road.

At Iberia Parish, La., recently the sheriff destroyed by dynamite a bridge and a trestle of the Southern Pacific which were declared to interfere with drainage rights of certain adjacent owners. The District Court had ordered the railroad to remove a portion of its track, but the order had not been obeyed. The sheriff had with him a force of 25 deputies and there were 1,000 spectators.

From Chicago, the fountain head of everything authentic in the way of railroad news, it is reported that President Roosevelt, in his annual message to Congress, will recommend two changes in the Interstate Commerce law; first, the legalization of railroad traffic associations, and second the enlargement of the Commission, making the number of members ten instead of seven.

The Pennsylvania Railroad has issued an order that all brakemen, Pullman conductors and porters must call out "all aboard" exactly two minutes before the train leaves a division terminal station. At towns where trains stop several minutes, passengers have a way of leaving and strolling up and down the platform and are apt to wait until the minute of starting to re-enter the train.

The Secretary of the Pennsylvania State Board of Trade announces that 70 per cent. of the men who have been elected to the next legislature of that state are pledged in favor of a law limiting passenger fares throughout the state to two cents a mile, and another authorizing the transportation of freight on street car lines. The Board of Trade wrote to every candidate before the election.

The Railroad Commissioners of Texas propose to issue an order requiring all railroads to run sleeping cars in any or all trains which the commissioners may specify, and also an order prescribing rates for berths 20 per cent. less than those now in force; and the railroads and all persons interested are notified to present their views on the subject on or before November 27, when a hearing will be held at Austin.

A press despatch from Omaha says that the Chicago, Burlington & Quincy has notified its clerks to keep out of labor unions. An organizer has been in Omaha and it was understood that arrangements were being made to form a clerks' union. In Texas recently large numbers of clerks in railroad offices have received increased pay and other favorable changes as a result, it is said, of the aggressive work of the leaders of a clerks' union.

At Minneapolis, November 8, the Grand Jury in the Federal Court returned indictments against the following railroads, railroad officers and shippers for giving or receiving illegal freight rates: Great Northern Railroad Company and 5 officers; Chicago, St. Paul, Minneapolis & Omaha Railroad and 3 officers; Wisconsin Central and 2 officers; Minneapolis & St. Louis and 2 officers; W. P. Devereaux Company; McCaull-Dinsmore Company; D. F. De Wolf; Ames-Brooks Company.

In the Federal Court at Kansas City, Nov. 13, the Grand Jury returned indictments against D. H. Kresky, a freight broker and W. A. McGowan, agent of the Nickel Plate Fast Freight Line, for conspiring to violate the Interstate commerce law in granting rebates on flour shipped from Wichita to England and Scotland, and against H. S. Hartley for accepting commissions and rebates on shipments of cottonseed meal over the St. Louis & San Francisco.

By the purchase of the town of Shire Oaks on the upper Monongahela river in Pennsylvania, the Pennsylvania Railroad becomes the owner of the Banner mines of the Pittsburg Coal Company, the First M. E. Church, the Shire Oaks Brewery, a hotel, a company store and fifty houses. All will be torn down to be replaced by a large freight yard for the coal trade. The community will move to Elben, several miles below. The improvements at Shire Oaks will cost several million dollars.

According to press reports, the North American Express Company, incorporated in Maine a few weeks ago with an authorized capital of $25,000,000, was organized by Rock Island interests and is to operate on the lines of that road, as well as over other lines. The United States Express, Wells Fargo & Co., the Pacific Express and the American Express now operate on the Rock Island lines. Some of the contracts expire on January 1, 1907, but others will run two years longer.

Cotton exporters of New Orleans are now exercised over the falling off in the export trade through that city since the railroads have complied with the law to make their rates open and undescriminating. According to the *Times-Democrat* cotton is now taken from Memphis to Boston by rail and thence to Liverpool at 62½ cents per 100 lbs., whereas the rate from Memphis to Liverpool by way of New Orleans is 67 cents. It is said that 7,000 bales have already been sent by way of Boston.

The Missouri Pacific announces that prizes are to be given in the roadway department, and that for the purpose of awarding the prizes a general inspection will be made each autumn. The first prize, $200, will go to the roadmaster having the best line and surface. The second is $100, and the third $50. There will be a section foremen's first premium of $25 on each division of the road; second premium, 10 days' leave of absence, with pass to any point on the road. There will also be lesser premiums for the section foremen, accompanied by placards to be displayed on the tool house of the premium sections.

According to the *Wall Street Journal*, rail manufacturers say that orders will have been booked by January 1, 1907, for the entire 1907 output of the rail mills of the country. It is estimated that orders for about 2,000,000 tons for 1907 delivery have already been given, and there will be left over from the current year about 200,000 tons of unfilled orders. The total capacity of the mills is about 3,500,000 tons, and it is said that negotiations for the differ-

ence between the orders given and the total capacity are already under way. No orders are being accepted for immediate delivery at a premium, all orders being taken at $28 per ton.

New freight tariffs have been filed with the Interstate Commerce Commission by the Union Pacific, which make wholesale reductions in rates to points in Utah and Idaho. They go into effect November 24. First and second class rates from Chicago will be reduced approximately 25 cents and third and fourth class rates 17 cents. Southern Idaho will profit in greater measure than Utah in the reductions that have been made. The first-class rate from Chicago to Pocatello now is $3.30. It will be lowered to $2.85.

Mr. Prall, of the Pittsburg Car Service Association, says that the newspaper reports of congestion in the freight yards of that city are incorrect. There is no trouble from congestion; the difficulty is the lack of cars. The railroads are doing better service than ever before. They are moving 20 per cent. more freight than ever before and yet with fewer cars than were in service two years ago. Mr. Prall estimates that the average capacity of cars has in two years increased 4 per cent., while the quantity of freight handled has increased over 20 per cent.

Plans for the Panama Canal.

The Isthmian Canal Commission has issued a statement describing the general plan for the construction of the Panama Canal. It is explained that the type of canal adopted by the Commission and approved by the minority of the consulting board is that with a summit level about 85 ft. above the level of the sea, which is to be reached by a flight of locks built at Gatun, on the Atlantic side, by one lock at Pedro Miguel and two others at La Boca, on the Pacific side. The locks are all to be in duplicate.

The summit level will be formed by building a large dam at Gatun and a small one at Pedro Miguel. A second lake, with a surface elevation of 35 ft., will be formed on the Pacific side between Pedro Miguel and Panama Bay by building a dam at La Boca, across the mouth of the Rio Grande, and another dam between Soca Hill and high ground near Corozal. From the Caribbean Sea to the mouth of the Mindi River a channel is to be excavated having a bottom width of 500 ft. and a depth of 45 ft. below mean tide. From the mouth of the Mindi to the Gatun locks the width and depth are to be the same as from the sea to the mouth of the river.

The Gatun locks are to be built in duplicate. The lift will be overcome by a flight of three locks of 28½ ft. or by two locks of 42½ ft. each. The Gatun dam will reach from a point near the Gatun Hills, on which the locks are to be located, to the hill, 3,500 ft. westward, in which the spillway will be built. The object of this dam is to form a reservoir in which the floods of the Chagres will be received. Its area will be 110 square miles. Works for regulating the level of the lake will be situated in the hills that lie midway between two extremes of the dam. They will consist of a system of gates constructed on foundations of concrete. The gates will be almost counterparts of those used on the Chicago Drainage Canal.

From the Gatun locks to San Pablo, about 15 miles, only a small amount of excavation will be required. The canal will be about 1,000 ft. wide and 45 ft. deep. Trees and undergrowth for 50 ft. along the shores are to be removed. Further up the lake, as the amount of excavation necessary to get a depth of 45 ft. increases, the width of the channel will be decreased, first to 800 ft., then to 500, then to 300 from Obispo to Las Cascades, about 1½ miles, where the Culebra cut begins.

The channel from Matachin to Bas Obispo may be narrowed to 100 ft. From Las Cascades to Paraiso, 4.7 miles, the width of the channel will be 200 ft. This is the hardest work of the whole canal construction. From Paraiso, the end of the Culebra cut, to the Pedro Miguel lock, something less than two miles, the channel will be 300 ft. wide. The Pedro Miguel lock will have a lift of 30 ft. and will be in duplicate, with approach walls at each end. From the lock for 1.87 miles the channel will be 500 ft. wide and will then be increased to 1,000 ft. for 3.61 miles to Sosa Hill, on the shore of Panama Bay, where the Sosa locks will be built. These locks will be in two flights, with lifts of 27½ ft. each, and will be in duplicate.

A dam will be built across the Rio Grande from San Juan Hill to Sosa Hill, another from Sosa Hill to Corozal Hill, and a small dam from Corozal Hill to the high ground eastward. These dams will form a lake to be known as Sosa Lake. It will have an area of eight square miles and will be provided with regulation works for discharging the surplus water. From the Sosa locks to deep water in Panama Bay, four miles, the channel is to have a bottom width of 500 ft. and a depth of 50 ft. below mean tide. The mean rise and fall of the tide is about 15 ft.

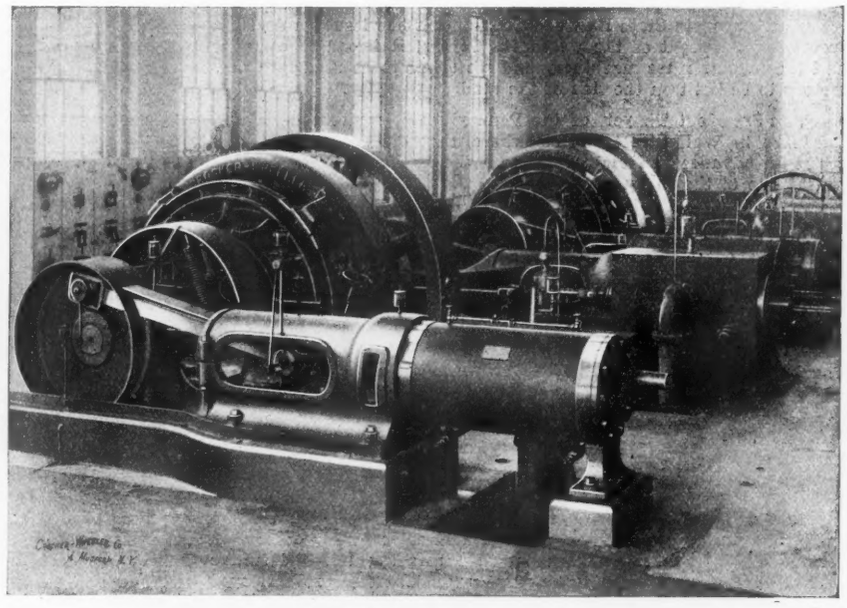
The Panama Railroad will be relocated throughout almost the entire distance from the mouth of the Mindi river to Panama, and some heavy embankments will be needed to cross certain parts of Gatun lake.

Guayaquil & Quito.

According to a circular issued by the President of the Guayaquil & Quito, 190 miles of road from Guayaquil, Ecuador, to Mocha, are in operation; this section includes the entire Mountain division which crosses the Chimborazo mountain, 11,800 ft. high. Grading and masonry work are finished on the remaining 96 miles into Quito, and rails are being laid at the rate of 4,000 to 5,000 ft. per day.

Generator for the Collinwood Shops of the Lake Shore.

The Lake Shore & Michigan Southern has recently installed in its repair shops at Collinwood, Ohio, a 300-k.w., 250-volt d.c. generator built by the Crocker-Wheeler Co. This generator runs at 150 r.p.m. with a current of 1,200 amperes. With the generator is used a three-unit balancing transformer through which currents of 80, 120 or 140 volts can be delivered to the individual motors for machine tool drive. The shops were already equipped with two 400-k.w. and one 75-k.w. compound wound, multipolar, slow speed engine-type generator mounted directly on the engine shafts. The smaller generator is connected to a 150-h.p. simple engine, and the 400-k.w. generators are driven by 650-h.p. cross compound Buckeye engines at 135 r.p.m.



Crocker-Wheeler Generator; Lake Shore Shops at Collinwood, Ohio.

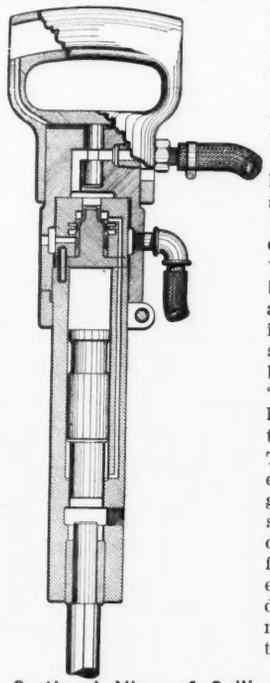
Changes in the Railroad Map of Texas.

Railroad extensions in Texas during the past year have been numerous and important. Since 1905 the Kansas City, Mexico & Orient has built its line northeast from Sweetwater to Knox City, about 75 miles, connecting with the Texas & Pacific at Sweetwater. The Texas Central has been extended west from Stamford to Dowell, about 50 miles, crossing the Kansas City, Mexico & Orient at Hamlin. The Wichita Valley has been extended south from Seymour to Stamford, about sixty miles. The Abilene & Northern, a new company which is controlled by the same interests that own the Colorado & Southern, the Fort Worth & Denver City and the Wichita Valley, has built a line from Stamford south to Abilene, about fifty miles, connecting with the Texas & Pacific at Abilene. This line is a continuation of the Wichita Valley. The Plainview & Northern Texas, which runs from Canyon City to Plainview, in Hale County, is a new line sixty miles long, controlled by the Atchison, Topeka & Santa Fe. It connects with the Pecos Valley (a part of that system) at Canyon City. In the southern part of the State the new line of the Galveston, Harrisburg & San Antonio between San Antonio and Cuero, sixty miles long, has been completed and is in operation. The St. Louis, Brownsville & Mexico has finished its line between Sinton and Algoa, 180 miles. In eastern Texas the Beaumont, Sour Lake & Western has been extended west from Sour Lake to a point near Vidette, about 30 miles. This is classed as a Colorado &

Southern project. The Orange & Northwestern, belonging to the same interests, has been extended north from Buna to Newton, thirty miles. The Trinity & Brazos Valley, which is to form the link in the Colorado & Southern system between Fort Worth and Houston, has been completed southeast from Mexia to Houston, about 150 miles, and also from Teague north towards Dallas, about 15 mies. The Houston & Texas Central has finished building its "cut-off" line between Mexia and Navasota, 100 miles. The Texas & Gulf has built south from Timpson to Waterman, 15 miles. The Jasper & Eastern (Santa Fe) has been built from Kirbyville Junction east into Louisiana, and the Northeastern Texas, a new line, has been built from Redwater southwest to Munz, about twelve miles.

Sullivan Pneumatic Hammer Drills.

A light one-man machine drill to replace hand work in mining and quarrying, and by contractors, is used for drilling "plug and feather" holes in quarries; pop holes for breaking up large masses of stone with explosives; drilling anchor holes; squaring up; cutting hitches; trimming walls of cuts and tunnels, etc. Some pneumatic hammer drills have been used for this purpose for several years and have cheapened the cost of such work. A drill of this type made by the Sullivan Machinery Co., Chicago, is illustrated herewith.



Sectional View of Sullivan Plug Drill.

All working parts are made of hardened tool steel with wide bearing surfaces to minimize wear. All non-working parts are made of steel in order to make the tool durable. The valve motion secures a hard, quick blow, which is adjustable to the character of the material in which the drill is used. The valve is cylindrical, designed for high or low pressure, and balanced. Wide direct ports obviate "wire-drawing" and freezing at the exhaust. The air is maintained at inlet temperature throughout its course. The drill cylinder is fitted at the lower end with removable steel bushings ground to a press fitted to receive the shank of the drill bit and formed to obviate the use of a special drift key for driving out the bushings. The two exhaust openings, from opposite cylinder ends, are tapped out for pipe connection to a blower hose which keeps the hole free from dust.

One of these drills has drilled 160 holes, ⅝ in. in diameter and 3 in. deep, both horizontal and vertical, in one hour, including time for changing bits. The best previous record is said to be 60 holes in an hour. In a later test, ⅝-in. holes averaging 5¼ in. deep were drilled in an average of 15 seconds each. Two classes of air drills are made: D-15¼ for holes 3 in. to 12 in. deep, and D-19 for holes 1 ft. to 4 ft. deep. There is also a steam driven drill, D-18, of the same capacity as the D-19. The D-15¼ weighs only 20 lbs. The D-19 weighs 30 lbs. and is therefore easily handled by one man.

Worked for New York Central 60 Years.

After faithful service of 60 years and three months in the employ of the New York Central & Hudson River Railroad and its predecessors, the New York Central Railroad and the Syracuse & Utica, James FitzGerald, the veteran crossing tender at the Mill street crossing in Rome, has resigned his position. When but 16 years old Mr. FitzGerald entered the employ of the road and he has been in the same service ever since. He first swept out the shops, then he "poisoned" the old wooden ties, then he boiled the old wooden keys in linseed oil, the old wooden rails being in use at the time he entered the service, the road then extending only from Utica to Syracuse. He began work August 1, 1846, and has ever since been on the payroll in various capacities for the last 16 years as tender of the Mill street crossing, at a salary of $36 a month. He will now draw a pension. When Mr. FitzGerald had been in the employ of the company 50 years he was asked if he did not want to retire on a pension, and he declined, saying he wanted to work as long as he could. The other day he was taken with a bad spell occasioned by his heart, which has given him considerable trouble of late, and fainted. He then saw that he could not trust himself any longer safely at his post and he sent in his resignation. Since he has been crossing tender there has not been a fatal accident at his crossing while he was on duty. Mr. FitzGerald is strictly a temperate man and his memory is wonderful. When he went to work for the company John Wilkinson, of Syracuse, was superintendent and Mr. Phelps the master mechanic. FitzGerald was foreman of the Central yard at Oneida 20 years. He was then transferred to Rome as switchman in the East Rome yard, holding that position till he was appointed gate tender, the position he now resigns. He does not use tobacco, nor does he drink tea or coffee.—*Utica Press.*

Talk About Increased Pay.

On the Boston & Albany passenger and freight conductors and brakemen have had their pay increased from 5 to 10 per cent. The newspapers report increases also in the pay of station and yardmen and telegraph operators, but it does not appear that these classes have been granted any general advance.

The railroads centering in Chicago, after protracted discussions with the officers of the Brotherhoods, have granted a material increase in pay to their yard conducters and brakemen. Press despatches say that the increase is four cents an hour, and that the yard men will demand the same increase at Pittsburg and other large cities. Some of the yard men belong to the Brotherhood of the Railway Trainmen, and these will receive the same increase.

The Delaware, Lackawanna & Western, after long continued negotiations with committeemen of the Locomotive Engineers' Brotherhood, has granted its enginemen an increase of pay. Neither the company nor the enginemen make any clear statement as to what the increase will amount to.

The Erie road has held protracted negotiations with the leaders of its firemen, with the result that "peace" was announced on Wednesday, though the magnitude of the grievances and the degree of success accomplished by the men cannot be understood from any of the statements given out.

The New York Central has agreed with its firemen that the electric locomotives which are to be put in use in New York City this month shall be manned, for the first six months, by an engineman and a "helper." The helpers will be former firemen, and will receive the same pay as firemen. At the end of six months the question of pay for this service will again be taken up. The New, York, New Haven & Hartford will probably make the same arrangement with the men who are to handle the electric locomotives on that road.

The Chicago, Milwaukee & St. Paul has increased the pay of firemen 7½ per cent., and of yard conductors and brakemen 14 per cent.

Those railroads which have already announced general advances in the wages of employees do not seem to escape the attention of the Brotherhood leaders and the newspaper reporters. On the Philadelphia & Reading and the Delaware, Lackawanna & Western the superintendents are said to be in conference with representatives of the labor unions considering various "serious" situations; but whether there is any seriousness in the matter, except from the newspaper standpoint, seems to be questionable. At Pittsburg the Brotherhoods of Brakemen and Firemen are said to be demanding increases of pay from the Pennsylvania Lines West of Pittsburg. Practically all the employees of these lines have been promised an increase of 10 per cent., but this, it is said, will positively not be accepted by the Brotherhood.

New Pennsylvania Yards at Hollidaysburg.

The Pennsylvania has completed its improvements at Hollidaysburg and now has a large freight yard with 55 miles of track. In the new yard there is a roundhouse with accommodations for 24 engines, a coal wharf, two 75-ft. turntables, four ash-pits with pneumatic hoists, traveling cranes and shop buildings.

Sherwin-Williams Annual Convention.

The twenty-sixth annual convention of the members of the sales department of the Sherwin-Williams Company was held recently in Cleveland, Ohio. During the five days of the convention officers of the company gave addresses on methods of selling to different classes of buyers and discussed the paints and varnishes made by the company. The most novel literature distributed at the convention was a book of "Songs of the Paints that Cover the Earth," in which popular songs are cleverly parodied in praise of the products and staff of the company. These conventions are not only thoroughly enjoyable for those that attend them, but are also of great value to both the company and its employees in stirring up enthusiasm and disseminating advice and ideas.

TRADE CATALOGUES.

Inter-Pole Motors.—The Electro-Dynamic Co., New York, sends a pamphlet containing testimonials in regard to inter-pole motors. Circular No. 29 is a reprint of an address on "Direct-Current Motor Design as Influenced by the Use of the Inter-Pole" by C. H. Bedell before the American Institute of Electrical Engineers. Circular No. 23 illustrates and describes four types of the inter-pole motors built by the company.

Pneumatic Hammers.—The Dayton Pneumatic Tool Co., Dayton, Ohio, sends a circular illustrating and briefly describing its

"Green" pneumatic hammers. Nine sizes are shown and information given regarding dimensions, work adapted for, weight, blows per minute and air consumption.

Pneumatic Turntable Mule.—A 20-page pamphlet of the Pilling Air Engine Co., Detroit, Mich., is devoted to its pneumatic mule for locomotive turntables. Half-tone and line engravings illustrate the device, the method of application is shown and a brief description given.

Signal Relay.—A 13-page bulletin of the McClintock Manufacturing Co., St. Paul, Minn., illustrates and describes the McClintock signal relay. It is a mercury-contact relay and its essential features are described and illustrated in detail by half-tones and line drawings.

High-Pressure Blowers.—Circular No. 140 of the B. T. Sturtevant Co. describes the use, construction and installation of high-pressure blowers. The pamphlet is well and fully illustrated.

Tie Handling Tool.—A cardboard mailing folder, describing the "Q. M. S." or Cafferty tie handling tool, is being distributed by the Quincy, Manchester, Sargent Co., Chicago.

Manufacturing and Business.

The Solid Steel Tool & Forge Co., Brackenridge, Pa., is adding machinery to double its die sinking capacity.

The Star Brass Manufacturing Co., Boston, Mass., has opened an office at 56 Fifth avenue, Chicago, in charge of H. J. Stow.

The Delaware, Lackawanna & Western has ordered from the Crocker-Wheeler Co. a 300-k.w., 480-volt, three-phase, 60-cycle generator for its Kingsland shops.

The Dayton Pneumatic Tool Co., Dayton, Ohio, is distributing a souvenir pencil holder and pencil with an inscription concerning "Dayton" pneumatic hammers.

J. W. Duntley, President of the Chicago Pneumatic Tool Co., sailed for Europe on November 6 for a five weeks' business trip in England, Scotland, France and Germany.

P. G. Ten Eyck, Treasurer of the Federal Railway Signal Company, has been appointed General Manager and Chief Engineer. Clarence E. Newman, Assistant Treasurer, has been appointed Treasurer and Secretary.

Richard S. Buck has resigned as Consulting Engineer of the New York City Bridge Department, effective December 1. Mr. Buck has been, for the past two months, a member of the firm of Sanderson & Porter, engineers and contractors.

The Kisner Construction Co., of Chicago, was the lowest bidder on both contracts Nos. 25 and 27 of the New York State barge canal work, bids for which were recently opened. The company offered to do the work for $1,754,236 on No. 25 contract and for $972,210 on No. 27 contract.

George A. Berry, until recently Engineer of Company Forces of the New York Central & Hudson River, has been elected Vice-President and General Manager of the Hicks Locomotive & Car Works, with office at Chicago, in charge of the plants and business of the company.

The Ralston Steel Car Company, Columbus, Ohio, is doubling the capacity of its plant. At the present time it is turning out 10 cars a day. By the first of the year it is expected to have an output of 20 cars daily. In addition the plant is turning out 20 to 25 steel underframes a day. Orders booked are sufficient to keep the plant busy for a year.

Iron and Steel.

The New York, New Haven & Hartford has given an order to Lewis F. Shoemaker & Co., Philadelphia, for 4,000 tons of overhead bridges to be used on its Harlem River branch.

Eastern mills report additional contracts for standard rails aggregating 10,000 tons; the Pittsburg mills have been given contracts by the South & Western for 27,500 tons for 1907 delivery. Seventeen thousand five hundred tons of this is to be furnished by the Carnegie Steel Company and 10,000 tons by the Pennsylvania Steel Company.

The St. Louis Frog & Switch Company has bought 5,000 tons of rails; the Ohio & Southern Traction Company 500 tons, and the California Gas & Electric Line 600 tons. The Louisville & Eastern has given an order to the Lackawanna Steel Company for 5,000 tons, and the Manistee & Northeastern one for 500 tons to the Pennsylvania Steel Co. The United Railways of St. Louis has ordered 500 tons, the Metropolitan Street Railway of Kansas City 1,100 tons, the Indianapolis Union Railway 1,000 tons, and the Terre Haute Traction & Light Company 1,000 tons.

OBITUARY NOTICES.

John C. Welling, Vice-President of the Illinois Central in charge of Accounting and of the Treasury department, died in Chicago on November 9th of bronchitis, after two weeks illness. Mr. Welling was born in New Jersey in 1840, and was educated at Lawrenceville, N. J., and Trenton. He began railroad work in 1866 on the Ironton Railroad in Pennsylvania, later becoming private secretary to the owner of the road. Since 1874 he has been on the Illinois Central. He began as Acting Secretary, and in a few months was appointed Assistant Treasurer. In 1876 he was made Auditor, and in 1883 Comptroller. From 1890 until his death he was Vice-President in charge of the Accounting and Treasury departments, having been elected also a member of the Board of Directors in 1892.

J. C. Welling.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

Engineer Club of Philadelphia.

At the meeting of this club to be held November 17, a paper will be presented by P. A. Maignen on "Purifying Water."

Canadian Society of Civil Engineers.

At a meeting of the Electrical Section of this society Nov. 15 a paper on "Polyphase Systems of Generation, Transmission and Distribution" by M. A. Sammett, A. M. Can. Soc. C. E., was read by the author.

Southern and Southwestern Railway Club.

At a meeting of this club at Atlanta, Ga., November 15, the programme included a paper on "Steel Work Construction" by W. E. Symons; also one on "Car Roofs and Doors" by Messrs. Bowers, Goodyear and Robider.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Illinois Central.—J. T. Harahan, who was recently elected President, was born in Massachusetts in 1843, and began railroad work in 1864 at Alexandria, Va., on the Orange & Alexandria, now part of the Southern. After working for six years on the Louisville & Nashville and other roads, he was, in 1872, made roadmaster of the Nashville & Decatur, now part of the Louisville & Nashville. In 1879 he was appointed Superintendent of the Memphis line of the Louisville & Nashville, and two years later was transferred to the New Orleans division. In 1883 he was appointed General Superintendent of the lines south of Decatur, Ala., and in 1884 was made General Manager of the entire road. The next year he went to the Baltimore & Ohio as General Superintendent of the Pittsburg division, but after a few months returned to the Louisville & Nashville as Assistant General Manager, being soon promoted to General Manager. In 1888 he went to the Lake Shore & Michigan Southern as Assistant General Manager, going later to the Chesapeake & Ohio as General Manager, and then being made General Manager of

J. T. Harahan.

the Louisville, New Orleans & Texas, now part of the Yazoo & Mississippi Valley. In 1890 he was elected Second Vice-President of the Illinois Central, which position he held until his recent election as President.

J. F. Titus, Local Treasurer at Chicago, has been appointed Assistant to the President, in charge of the Accounting and Treasury departments, succeeding to the duties of J. C. Welling, Vice-President, deceased.

L. W. Fritch has been appointed Assistant to the President, succeeding W. L. Smith, who has been made general agent at Memphis, Tenn., reporting to the President.

Mexican Central.—A. A. Robinson, President, has resigned. Eben Richards, Vice-President and General Counsel, has been elected Acting President.

Mobile & Ohio.—See Southern Railway in Mississippi.

Rock Island Company.—G. T. Boggs, Assistant Treasurer, has been elected Vice-President, Secretary and Treasurer. J. J. Quinlan, Vice-President, has been elected also Assistant Secretary and Assistant Treasurer.

Southern.—See Southern Railway in Mississippi.

Southern Railway in Mississippi.—E. L. Russell, Vice-President and General Counsel of the Mobile & Ohio, has been elected also Vice-President of the Southern Railway in Mississippi, which is the name under which the Southern Railway's line from the Alabama state line to Greenville, Miss., 179 miles long, including two branches, is hereafter to be operated. The authority of A. H. Plant, Comptroller of the Southern; H. C. Ansley, Treasurer of the Southern, and W. S. Cooke, Auditor of the Mobile & Ohio, has been extended over the Southern Railway in Mississippi. Henry Tacon, Secretary and Treasurer of the Mobile & Ohio, has been also appointed Assistant Treasurer of the Southern Railway in Mississippi, and the jurisdiction of the heads of other departments of the Mobile & Ohio has been extended over the Southern Railway in Mississippi.

Seaboard Air Line.—A. R. Duval and Y. Vandenburg, both of New York, have been elected Directors, succeeding J. M. Barr and J. B. Dennis.

Operating Officers.

Chicago, Indianapolis & Louisville.—J. B. Sucese, trainmaster at Lafayette, Ind., has been appointed General Superintendent, succeeding G. K. Lowell, resigned.

St. Louis & San Francisco.—A. J. Sams, trainmaster at Fort Scott, Kan., has been appointed Superintendent at Birmingham, Ala., of the new division extending from Birmingham, Ala., to Memphis, Tenn., heretofore a part of the Southern division.

Vandalia.—F. H. Worthington, Superintendent at Decatur, Ill., has been appointed Superintendent at Logansport, Ind., succeeding I. W. Geer, transferred. F. L. Campbell, trainmaster at Terre Haute, Ind., succeeds Mr. Worthington.

Wheeling & Lake Erie.—C. V. Wood, Superintendent of the Cleveland division, has been appointed Superintendent of the Toledo and Pittsburg divisions, with office at Canton, Ohio, succeeding C. A. Van Dusen, resigned to go into other business. C. W. Coe, Assistant Superintendent at Canton, Ohio, succeeds Mr. Wood, with office at that place.

A. P. Titus, Car Accountant, has been appointed Superintendent of Car Service and his former title has been abolished.

Traffic Officers.

Chicago, Peoria & St. Louis.—Charles W. Galligan, who was recently appointed Assistant General Freight Agent, in sole charge of the freight department, was born in Illinois in 1868. After a High School education he began railroad work in 1886 in the local freight office at Cairo, Ill., of the Cairo, Vincennes & Chicago, now the Cairo division of the Cleveland, Cincinnati, Chicago & St. Louis. He was appointed chief clerk to the General Freight Agent of this road in 1890, and after its consolidation with the Big Four was made chief clerk to the Assistant General Freight Agent. In 1891 he was transferred to St. Louis, and two years later was made contracting agent of the Cleveland, Cincinnati, Chicago & St. Louis. In 1895 he was appointed Assistant General Freight Agent of the St. Louis, Chicago & St. Paul, and was appointed General Freight Agent of that road in 1897; when it was consolidated with the Chicago, Peoria & St. Louis, in 1898, he was made Assistant General Freight Agent of both companies. Since 1902 he has been chief clerk of the Chicago, Peoria & St. Louis.

Wisconsin & Michigan.—The office of J. C. Fitzgerald, General Freight and Passenger Agent, has been removed from Menominee, Mich., to Chicago, Ill.

Engineering and Rolling Stock Officers.

Cincinnati, Hamilton & Dayton.—R. D. Fidler, foreman of the Chicago, Indianapolis & Louisville roundhouse at Lafayette, Ind., has been appointed Assistant Master Mechanic of the C., H. & D. at Indianapolis, Ind.

Cleveland, Cincinnati, Chicago & St. Louis.—W. B. McLoughlin has been appointed Division Engineer, with office at Evansville, Ind., in charge of the construction of the Evansville, Mt. Carmel & Northern, which is to be built from Evansville northwesterly 35 miles to a connection with the C., C., C. & St. L. at Mt. Carmel, Ill.

Detroit, Toledo & Ironton.—A. J. Ball, Master Mechanic of the Toledo Railway & Terminal, has been appointed Master Mechanic of the D., T. & I. at Springfield, Ohio.

Oregon Short Line.—H. E. Roberts has been appointed Division Engineer at Pocatello, Idaho, succeeding R. B. Ketchum, resigned.

Toledo Railway & Terminal.—C. L. Acker, roundhouse foreman of the Baldwin Locomotive Works, has been appointed Master Mechanic of the Toledo Railway & Terminal, with office at Toledo, Ohio, succeeding A. J. Ball. See Detroit, Toledo & Ironton.

LOCOMOTIVE BUILDING.

The Gould Lines, it is reported, are about to order a large number of locomotives.

The Guayaquil & Quito, Broad Exchange Building, New York, will shortly be in the market for several locomotives.

The United States Reclamation Service has ordered from the American Locomotive Co. four simple locomotives with 10 x 16-in. cylinders.

The Pennsylvania, as reported in our issue of November 9th, has ordered from its Juniata shops 25 consolidation (2-8-0) type locomotives. These locomotives will weigh 225,000 lbs., and will have 3,850 sq. ft. total heating surface, cylinders 24 x 28 in., and drivers 62 in. in diameter.

The Buffalo, Rochester & Pittsburg has ordered from the American Locomotive Co., for July, 1907, delivery, six simple decapod (2-10-0) locomotives. These engines will weigh 275,000 lbs., with cylinders 24 in. x 28 in., Walschaert valve gear, drivers 52 in. in diameter, radial stayed boiler, tank capacity 9,000 gallons, and coal capacity 14 tons.

CAR BUILDING.

The Pere Marquette has ordered 1,500 coal cars for June, 1907, delivery.

The Seattle Electric Company has ordered eight 34-ft. flat cars from the Hicks Locomotive & Car Works.

Swift & Co. are building 200 34-ft. refrigerator cars at their own shops for March to June, 1907, delivery.

The Des Moines, Iowa Falls & Northern has ordered three Hart convertible Rodger ballast cars of 80,000 lbs. capacity.

The Vandalia has ordered 25 Hart convertible Rodger ballast cars of 100,000 lbs. capacity for March, 1907, delivery.

The Keweenaw Central has ordered 10 gondola cars of 60,000 lbs. capacity from the Hicks Locomotive & Car Works.

The New York, New Haven & Hartford has ordered 500 refrigerator cars from the American Car & Foundry Company.

The Las Vegas & Tonopah has ordered three chair and three combination cars from the Pullman Co., for March, 1907, delivery.

The Intercolonial has ordered three motor cars for delivery next spring and will order seven more when these three have been built.

The Richmond, Fredericksburg & Potomac has ordered from the Rodger Ballast Car Co. 20 Hart convertible cars of 80,000 lbs. capacity.

The Forest City Railway, Cleveland, Ohio, has ordered four 40-ft. flat cars from the Hicks Locomotive & Car Works, to be used in construction work on their road.

The Chicago, Rock Island & Pacific has ordered a number of passenger coaches, chair cars, dining cars and observation cars from the Pullman Company for 1907 delivery.

The Chicago & Illinois Midland has ordered 240 36-ft. gondola cars of 80,000 lbs. capacity from the Hicks Locomotive & Car Works. The special equipment includes Simplex bolsters.

The Quebec, Montreal & Southern has ordered 1,500 steel underframe box and stock cars of 60,000 lbs. capacity from the Canada Car Company for delivery beginning February 1, 1907.

The Central of New Jersey is asking bids on a number of com-

posite steel passenger cars, and is building at its Elizabethport, N. J., shops five baggage cars and one air-brake inspection car.

The Wabash, as reported in our issue of November 9, is in the market for 4,000 steel hopper cars of 100,000 lbs. capacity, and 3,000 wooden box cars of 80,000 lbs. capacity. The hopper cars will weigh 38,600 lbs. and measure 31 ft. 6 in. long, 10 ft. wide and 10 ft. 5 in. high, over all. The box cars will be 41 ft. ¾ in. long, 9 ft. 1¼ in. wide, and 14 ft. 5 in. high, over all.

The Toledo & Ohio Central has ordered 100 steel flat cars of 80,000 lbs. capacity from the Pressed Steel Car Co., for July, 1907, delivery. The special equipment includes:

Bolsters	Body-Pressed Steel Car Co.'s Truck
Brake-beams	Simplex
Couplers	Tower
Draft rigging	Miner
Truck springs	American
Journal boxes	McCord

The Minneapolis, St. Paul & Sault Ste. Marie has ordered 19 second class coaches, eight tourist sleeping cars, eight first class sleeping cars, four first class coaches, two dining cars, two baggage cars, eleven 70-ft. combination mail and baggage cars and four compartment observation cars, as reported in our issue of October 26, and also three combination passenger and baggage cars, one combination buffet and baggage car and one mail car from Barney & Smith. The second class coaches will weigh 77,500 lbs. and measure 54 ft. 9 in. long, over sills. The tourist sleeping cars will weigh 111,000 lbs. and measure 70 ft. long, over sills. The first class sleeping cars will weigh 120,000 lbs., and measure 73 ft. long, over sills. The first class coaches will weigh 102,000 lbs., and measure 64 ft. 6 in. long, over sills. The dining cars will weigh 117,500 lbs. and measure 70 ft. long, over sills. The baggage cars will weigh 95,000 lbs. and measure 70 ft. long, over sills. The special equipment for all cars giving the weight includes:

Brake-beam	Simplex
Brake-shoes	Walsh
Brakes	Westinghouse
Brasses	National-Fulton
Couplers	Washburn
Heating system	Gold duplex
Journal boxes	McCord

RAILROAD STRUCTURES.

Atlanta, Ga.—The Atlanta, Birmingham & Atlantic, according to local reports, will shortly start work on large passenger terminals here.

Calgary, Alb.—The City Engineer has prepared plans for a bridge to be built across the Bow River. It will consist of five spans with a total length of 625 ft. and 18-ft. roadway, with passenger walks on each side. Address Alderman Jones.

Knoxville, Tenn.—A contract has been given by the Southern Railway to Borches, Warhrep & Co., of Knoxville, at about $200,000 for building additions to its Coster shops. Work is to be started at once.

Miami, Fla.—The Florida East Coast is planning to put up a new machine shop here.

Minneapolis, Minn.—The Minneapolis, St. Paul & Sault Ste. Marie is planning to put up at Shoreham a new boiler shop 118 ft. x 206 ft., also a locomotive roundhouse to cost about $70,000.

St. George, N. B.—The Public Works Department at Ottawa is preparing plans for a steel bridge to be built over the Magaguadavic River here. Fred. Gelinas is Secretary of the department.

Salt Lake City, Utah.—The Southern Pacific will soon decide upon the plans for the proposed passenger station to be built at the foot of South Temple street, near Third.

San Francisco, Cal.—Plans are being considered for a one-story steel freight shed, covering a large area, to replace the wooden shed recently destroyed by the fire at Fifth and Townsend streets.

Sidney Mines, N. S.—The Intercolonial will build a new passenger station here.

Virden, Man.—The Canadian Northern has bought a site here for a new passenger station.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Atchison, Topeka & Santa Fe.—President E. P. Ripley, of this company, is quoted as saying that the first construction work to be done on the three new lines the company is planning to build in Oklahoma will be on a line 40 or 50 miles long running east from Woodward. Work will also be started on the line northwest from Oklahoma City next year. A contract is reported let to A. H. Moore, of Newton, Kan., for work on the Seiling Line, which will connect with the main line at Alston and run southeast through Moscow, Mutual and Richmond to Seiling.

Atlanta & Carolina (Electric).—This company has applied to the City Council of Atlanta, Ga., for a franchise to use certain streets in Atlanta on its proposed electric line to be built from Commerce southwest to West Point. (Sept. 21, p. 75.)

Austin & Goldfield.—A new railroad from Austin, Nev., to Tonopah and Goldfield, via Manhattan, is being promoted, it is said, by the Philadelphia capitalists who backed the original Tonopah-Goldfield road. A connection with the Battle Mountain line is contemplated.

Baltimore & Ohio.—An officer writes that plans for the proposed freight line around Baltimore, Md., to be known as the Patapsco & Susquehanna branch, are held in abeyance awaiting a court decision in connection with the petition filed by a property owner along the route. The proposed route is from Gorsuch station in Carroll County, through Carroll and Baltimore counties, to the Western Maryland, east of Pikesville; thence under the Reisterstown turnpike by means of a tunnel; thence crossing the Northern Central near Rider station, passing north of Towsontown to a crossing of the Maryland & Pennsylvania near Oakleigh; thence to a connection with the Philadelphia division east of Baltimore at or near Sewall. The line will be about 40 miles long. Most of the grades will be $^{3}/_{10}$ per cent. and the maximum $^{5}/_{10}$ per cent. (Nov. 2, p. 122.)

Berkeley Traction.—Incorporated in California, with $200,000 capital. The project is understood to be controlled by the Oakland Traction Consolidated, of Oakland, which is allied to the San Francisco, Oakland & San Jose Railway. Extensions north from Berkeley, Cal., are projected by these interests. The incorporators include Louis Titus, Walter H. Leimert, Duncan McDuffie, P. T. Tompkins and C. C. Young.

Billings & Northern.—See Great Northern.

Brandon, Saskatchewan & Hudson's Bay.—See Great Northern.

Canadian Northern.—Surveyors are at work running lines for a branch from Neepawa to Shoal Lake which will eventually be extended to Saskatoon, Sask.

Chicago, Milwaukee & St. Paul.—A contract is reported let by this company to Nelson Bennett, of Spokane, to construct a tunnel 8,750 ft. long through the Bitter Root mountain range, between the states of Montana and Idaho. In addition to this work Mr. Bennett has contracts for grading in Montana and Idaho, both east and west of the tunnel. This grading will average 100,000 cubic yards to the mile, nearly all of which is solid rock. On this stretch of roadway are a number of shorter tunnels and some heavy trestle work. Work is to begin shortly.

Cincinnati, Bluffton & Chicago.—Surveys are being made for extending this road from Bluffton, Ind., northwest to Huntington, 23 miles. As soon as the surveys are completed contracts for the work will be let.

Crystal River & San Juan.—Incorporated in Colorado with $100,000 capital to build a line 15 miles long from Placita, the present terminus of the Crystal River Railroad, to marble quarries at Marble, in Gunnison county. The project is backed by eastern capital, and work has been begun. The incorporators include Channing F. Meek, Samuel I. Heyn, Secretary of the Victor Fuel Company, Tandy A. Hughes, George H. Hill, Branch H. Giles, Walter F. Schuyler and Henry P. Lowe.

Dakota & Great Northern.—See Great Northern.

Dawson, El Paso & Southwestern.—Incorporated in New Mexico, by the Phelps-Dodge Co., to build a line from the coal camp of that firm at Dawson, N. Mex., south to Corona, on the El Paso & Southwestern. The line has been surveyed to Las Vegas and work is to begin in the spring.

Delaware & Hudson.—Under the name of the Quebec, Montreal & Southern, the holding company for D. & H. lines in Canada, this company proposes to build a line to Quebec. A contract has been given to O'Brien & Mullarkey for building the section from Pierreville, Que., to St. Philomene, 48½ miles, at which place the line will cross the Lotbiniere & Megantic.

Detroit & Mackinac.—Announcement is made by this company that it will build a branch from Alpena, Mich., west towards Boyne City. Preliminary surveys will begin soon. The new line may connect with the Boyne City, Gaylord & Alpena, now in operation as far as Gaylord.

Falmouth.—An officer writes that this company, which was recently incorporated in Virginia to build 25 miles of road, is undecided as to its route, difficulties having been encountered in securing the right of way. Still, it is expected to let contracts for the work within 30 days. There are to be two steel bridges. (Nov. 2, p. 123.)

Farmer's Grain & Shipping Co.—See Great Northern.

GREAT NORTHERN.—This company's report for the year ended June 30, 1906, shows that the work under way at the close of the previous report which has since been completed, brief mention of which was made in our issue of November 2d, includes the Dakota & Great Northern, from York to Thorne, N. Dak., 34.68 miles; Towner to Maxbass, N. Dak., 12.76 miles; West Hope to Antler, 12.76 miles; Munich to Sarles, 23.53 miles; Allendale to Forbes, 13.36 miles; St. Johns to the International boundary, 3.88 miles. The Washington & Great Northern, from Curlew, Wash., to Ferry, on the International boundary, 14.52 miles, is now in operation. Grading is nearly completed and track laying was commenced last June on the line being built by the Washington & Great Northern and the Vancouver, Victoria & Eastern from Midway to Keremos. The extension of the Farmers Grain & Shipping Co., from Starkweather to Hansboro, N. Dak., was completed in October of last year. The Minneapolis & Great Northern Company's extension from Greenbush to Warrold, Minn., 44 miles, is graded, but track will not be laid this year. The Eastern Railway of Minnesota, in addition to many side tracks, has built several mining branches ranging from one to three miles long. The work now under construction on Great Northern lines includes the Dakota & Great Northern from Aneta to Devil's Lake, N. Dak., 58.60 miles, which is to be completed during the present month to shorten the main line between St. Paul and the west. This line is being laid with 85-lb. rails and will help to relieve the congestion of traffic on the present line between Devil's Lake and Grand Forks. It is expected to complete the line from Barthold to Crosby, 89 miles, about the first of next month. The line from Thorne to Dunseith, seven miles, has been opened for traffic. On the Billings & Northern grading was commenced last June from Armington to Laurel, Mont., 199.29 miles. The new line is to form a connection between the Great Northern and the Montana Central on the north and the Northern Pacific and the Burlington roads on the south, as well as open up a new section in central Montana. The Brandon, Saskatchewan & Hudson's Bay, being built from a connection at the International boundary, with the Dakota & Great Northern Company's extension from St. Johns, N. Dak., to Brandon, Man., 69.45 miles, has just been completed. The Midland of Manitoba from Neche, N. Dak., to Portage la Prairie, Man., 77.01 miles, will be opened this month. Surveys for several other new lines have been made during the year, and work on them is now in progress. During the year the company completed a passenger station at Seattle, Wash., which, with the tunnel under the city, is used jointly with the Northern Pacific. The company also built 13,113 ft. of stone sea wall along Puget Sound between Everett and Ballard. At Sioux Falls, S. Dak., a brick passenger station has been put up. A track 1.23 miles long has been built at Fargo, N. Dak., connecting the Great Northern and the Northern Pacific, and many other passing and yard tracks have been put in or extended during the year. The company is also building a new main line, 4.52 miles long, between Grand Forks Junction and Schuermeier, N. Dak., to connect the line at Neche with the new freight terminal at Grand Forks.

It is reported in Spokane that this company will soon begin improvements on its line in Montana to cost about $8,000,000. The plans contemplate the change of over 100 miles of the main line, beginning at Cut Bank, on the east side of the Rocky Mountains and ending at Belton, on the west side. The distance by the present line between these two points is 105 miles, and the proposed line is to be 17 miles shorter. The new survey includes a tunnel a mile long through the mountains.

Contracts are reported let by this company to Ironsides, Rannie & Campbell and the British Columbia General Contract Co., both of Vancouver, B. C., for the construction of 50 miles of the line from New Westminster, B. C., to Blaine, Wash., via Cloverdale.

ILLINOIS CENTRAL.—It is reported that this road is planning to build an extension to Minneapolis, Minn., and possibly to the Lake Superior region and the copper country.

ILWACO RAILWAY & NAVIGATION.—See Oregon Railroad & Navigation Co.

KLONDYKE MINES.—Bloomfield Smith, representative of this company at Dawson City, has received instructions to at once make arrangements for a 55-mile extension from Sulphur Springs, to be built as soon as possible in the spring. It is believed to be the intention of this company to build a direct line between Dawson City and Edmonton, Alberta.

LAKE CHARLES NORTHERN.—Incorporated by Southern Pacific interests in Louisiana to build a line from a point at or near Lake Charles, La., north to De Ridder, in the parish of Calcasieu, about 50 miles. G. W. Nott is President; J. A. Bell, Vice-President, and G. G. Moore, Secretary and Treasurer.

LAKE SHORE SOUTHERN.—According to reports from Marquette, Mich., a mortgage of $12,000,000 has been given by this company to the Knickerbocker Trust Company, of New York, to secure bonds which it is proposed to sell to build a new line between Madison, Wis., and Huron Bay, Lake Superior, 200 miles. At Madison the new line will connect with the northern terminus of the Illinois Central.

LONG ISLAND.—Work is being pushed by this company on a new short cut route between Jamaica and Far Rockaway, and it is expected that the road will be finished about June 1 of next year. The new road starts at the sub-power station at Springfield, on the South Side division, and runs in a direct line to Cedarhurst, where it joins the Rockaway division. It is seven miles long.

MADRAS & EASTERN.—A company under this name is reported as having completed surveys from Madras, Ore., east for 30 miles. The company proposes to build a line from Madras east to Ontario, on the Oregon Short Line, about 225 miles. W. H. Houston, of Prineville, Ore., is President.

MEXICAN ROADS.—A line about 60 miles long is to be built in the Sierra Madres of western Mexico by Col. W. C. Greene and associates. It will run from Temosachic, state of Chihuahua, to the timber lands of the Sierra Madre Land & Lumber Co. Col. Greene is also at the head of the lumber company. The construction of the railroad will be paid for by an issue of $3,000,000 bonds on the lands and other property of the lumber company. These timber lands aggregate more than three million acres. The new railroad will connect with the Chihuahua & Pacific at Temosachic.

MIDLAND OF MANITOBA.—See Great Northern

MINNEAPOLIS & GREAT NORTHERN.—See Great Northern.

MISSISSIPPI ROADS.—W. Denny & Co. write that they have completed 19 miles of the line that they are building from Moss Point, Miss., north 40 miles through Jackson County to Donavan, on the M. J. & K. C. The steel bridge over Dog river has been completed and is now in use. (Nov. 2, p. 123.)

MISSOURI, KANSAS & TEXAS.—Surveys have been made by this company for a line from its Shreveport division at Waskom, Tex., south to Port Arthur, about 180 miles. The proposed new line will give the M., K. & T. a direct additional outlet to a Texas port.

MISSOURI PACIFIC.—It is said that the Weatherford, Mineral Wells & Northwestern road, which runs from Weatherford, Texas, west to Mineral Wells, is to be extended west 25 miles, connecting with the Texas & Pacific. This road was bought about two years ago by the Goulds to form part of a new line to Trinidad, Colo. The plans include the extension of the line northwest from Mineral Wells to Trinidad, about 600 miles. Final surveys for the first 150 miles from Mineral Wells have been completed, and grading contracts will soon be let.

NEW ORLEANS GREAT NORTHERN.—Announcement is made that construction work on the Jackson end of this road will begin immediately. The southern end of the line has been completed from Slidell, La., north to the Mississippi state line, 51 miles. The completion of the north end to Monticello would leave a gap of only about 40 miles between Monticello and the state line. The company hopes to be able to fill this gap without serious delay, although injunction suits are pending against it in the courts of Marion County. Routes for branch lines are under survey. (Nov. 2, p. 123.)

OREGON & WASHINGTON.—See Union Pacific.

OREGON RAILROAD & NAVIGATION CO.—A contract has been let to Erickson & Peterson for extending the Ilwaco Railway & Navigation Company's line from the present southern terminus at Ilwaco, Wash., east 13½ miles to a point a short distance west of Knappton. The extension will cost approximately $280,000. Work will be started at once, the plan being to complete the work not later than next spring.

QUEBEC, MONTREAL & SOUTHERN.—See Delaware & Hudson.

ROCHESTER, SYRACUSE & EASTERN (ELECTRIC).—This road, which was opened last spring from Rochester, N. Y., east to Lyons, 37 miles, is projected to Syracuse, a total distance of 87 miles. The company is controlled mainly by Syracuse capitalists, of which Lyman C. Smith is President. It will cost $6,000,000 to complete the road. Much of the road bed traverses private right of way and is of substantial construction. The power house equipment includes Westinghouse-Parsons steam turbines and Westinghouse turbo-generators. The cars weigh approximately 50 tons. They are 54 ft. long and 8½ ft. wide. Each car is equipped with four 125-h.p. Westinghouse motors, Westinghouse multiple unit control and air-brakes. The company will run express trains 50 to 60 miles an hour. It is expected that the entire road from Rochester to Syracuse will be completed and in full operation by January 1, 1908.

SAGINAW, OWOSSO & LANSING (ELECTRIC).—According to J. A. Thick, of Detroit, who is promoting this road, a company under this name will be incorporated in Michigan with $1,500,000 capital to build an electric line from Lansing, Mich., northeast to Saginaw. Rights of way have already been secured. A contract has been made with the Saginaw Valley Traction Co. to enter Saginaw over the tracks of that company, and negotiations are pending with the

Michigan United Railway Co. to enter Lansing over the Pine Lake road.

SOUTHERN.—Plans are being made by this company to double track and straighten the line between Atlanta and Gainesville, 53 miles.

SWAN CREEK.—Incorporated in Tennessee with $50,000 capital by J. H. Ellis, W. H. Northcutt, W. H. Bruce, E. W. Hines and J. B. Keeble. The company proposes to build a line from a connection with the Nashville, Florence & Sheffield division of the Louisville & Nashville near Mt. Pleasant through Maury County to Weatherly, in Hickman County, approximately 17 miles.

UNION PACIFIC.—The survey of the route for the Oregon & Washington from the Columbia River to Tacoma will soon be completed and the route will be announced some time this month. (Sept. 21, p. 75.)

VANCOUVER, VICTORIA & EASTERN.—See Great Northern.

WASHINGTON & GREAT NORTHERN.—See Great Northern.

WEATHERFORD, MINERAL WELLS & NORTHWESTERN.—See Missouri Pacific.

WEST CHESTER STREET RAILWAY.—The line of this company has been completed from West Chester, Pa., to Coatesville, completing a through line from 63d and Market streets, Philadelphia, to First avenue and Main street, Coatesville.

RAILROAD CORPORATION NEWS.

ALABAMA, TENNESSEE & NORTHERN.—This is the new name of the Carrollton Short Line, which runs from a junction with the Mobile & Ohio at Reform, Ala., to Aliceville, 21 miles.

BOSTON & MAINE.—Gross earnings for the three months ended September 30, 1906, were $11,219,155, an increase of $769,568; net earnings $3,353,434, an increase of $69,513.

CARROLLTON SHORT LINE.—See Alabama, Tennessee & Northern.

GEORGIA SOUTHERN & FLORIDA.—Gross earnings for the year ended June 30, 1906, of this company, which is a subsidiary of the Southern and owns 392 miles of road between Macon, Ga., and Palatka, Fla., and between Valdosta, Ga., and Grand Crossing, Fla., were $1,944,946, an increase of $230,244; net earnings, after taxes, $425,286, an increase of $22,969. The net income was $160,159, an increase of $24,482. Regular dividends of 5 per cent. on the $684,000 first preferred stock, and 4 per cent. on the $1,084,000 second preferred stock were paid, leaving a surplus for the year of $82,599, an increase of $24,482.

ILLINOIS CENTRAL.—Gross earnings for the three months ended September 30, 1906, were $13,495,940, an increase of $1,751,049; net earnings, after taxes, $3,711,102, an increase of $629,379. During the corresponding period in 1905, the Illinois Central, like most southern roads, suffered heavily from the yellow fever embargo at New Orleans.

INTERBOROUGH RAPID TRANSIT.—The Appellate Division of the New York State Supreme Court has ruled in a suit for damages brought against the Manhattan Elevated, a subsidiary of the Interborough, that an action begun by a tenant does not prevent that suit being outlawed as to the landlord. The suit in question was for damages done the plaintiff by the operation of the Manhattan Elevated beginning in 1880, and suit was not entered by the owner of the property until 1901, although the tenant of the property had brought suit earlier. This decision, it is said, will affect several hundred claims against the Interborough, so that the company will get a favorable decision in cases aggregating $1,000,000 in claims for damages.

KANSAS CITY, FORT SCOTT & MEMPHIS.—Blair & Co., New York, are offering, at 82 and interest, a block of the $19,143,000 outstanding 4 per cent. refunding mortgage bonds of 1936 of this company, guaranteed principal and interest by the St. Louis & San Francisco, which leases the road. These bonds are secured by a mortgage on 1,200 miles of main line and branches between Kansas City, Mo., and Birmingham, Ala. These bonds will become a first lien on this property as soon as the divisional mortgage bonds are refunded. Of the $60,000,000 authorized, $30,376,770 are reserved for refunding, $2,032,500 reserved to provide for improvements not exceeding $600,000 per year, and the remainder is issuable for additional lines and extensions at the rate of $22,500 per mile.

KANSAS CITY, MEXICO & ORIENT.—The Mexican Government has paid to this company $500,000 subsidy on 62 miles of road completed from Minaca, State of Chihuahua, west.

NEW YORK CENTRAL & HUDSON RIVER.—See Rutland Railroad.

NEW YORK CENTRAL LINES.—Gross earnings for October were as follows:

	October, 1906.	—Inc. or dec.—	
New York Central & Hudson River	$8,592,458	Inc.,	$454,082
Lake Shore & Michigan Southern	3,761,665	Inc.,	357,634
Lake Erie & Western	450,793	Dec.,	21,900
Chicago, Indiana & Southern	211,600	Inc.,	21,219
Michigan Central	2,421,325	Inc.,	174,578
Cleve., Cin., Chicago & St. Louis	2,270,095	Inc.,	202,413
Peoria & Eastern	282,641	Dec.,	11,795
Cincinnati Northern	84,731	Inc.,	5,550
Pittsburg & Lake Erie	1,272,168	Inc.,	97,328
Rutland	266,797	Inc.,	14,083
New York, Chicago & St. Louis	848,609	Inc.,	5,482
Total	$20,462,882	Inc.,	$1,298,674

NORTHERN PACIFIC.—Estimated gross earnings for the month of October, 1906, of the lines owned, were $6,896,422, an increase of $728,223.

OREGON SHORT LINE.—It is reported that the Harriman interests have bought a majority of the $2,062,500 outstanding common stock of the Utah Light & Railway Company, which owns and operates 88 miles of track in Salt Lake City, and also controls the electric lighting of the city.

PENNSYLVANIA.—There were outstanding, on November 10, as listed on the Philadelphia Stock Exchange, $99,626,000 convertible 3½ per cent. bonds of 1915, and $305,991,000 capital stock.

PULLMAN COMPANY.—At the annual meeting on November 14th the stockholders approved the following plan for the distribution of the surplus: The outstanding capital stock is to be increased from $74,000,000 to $100,000,000, and the new stock, as well as $640,000 treasury stock, will be divided among the present shareholders at the rate of 36 shares for every 100 shares already held. The regular dividend of 8 per cent. annually to be continued. The surplus on hand July 31, 1906, was $27,122,020, or 31 per cent. of the present capital stock. Quarterly dividends of 2 per cent. have been paid since November, 1899. The Directors decided to spend $1,000,000 for a steel car plant.

RIO GRANDE, SIERRA MADRE & PACIFIC.—See Rock Island Company.

ROCK ISLAND COMPANY.—It is reported that interests identified with this company have bought the Rio Grande, Sierra Madre & Pacific, which runs from El Paso, Tex., to Terrazas, Mex., 136 miles. W. C. Greene, President of the Greene Consolidated Copper Company, is President of the R. G., S. M. & P. and, with associates, controls it.

RUTLAND RAILROAD.—The minority holders of the $9,057,600 outstanding preferred stock of this company have issued a circular describing their attempt to get a distribution of the accumulated dividends on their stock at the recent annual meeting. They asked that common stock to the extent of 25 per cent. of the accumulated dividends, which are said to aggregate 160 per cent. on the preferred stock, only 1½ per cent. having been paid so far in 1906, nothing in 1905 and 1904, and varying amounts previously, should be issued to the preferred stockholders, and that the preferred stock should hereafter be non-cumulative, the dividend rate to be reduced from 7 per cent. to 5 per cent. yearly, but that the New York Central & Hudson River, which controls the road, should guarantee this dividend. No action was taken on this proposal. The preferred stockholders contend that the surplus is being put into unnecessary betterments.

ST. LOUIS & SAN FRANCISCO.—See Kansas City, Fort Scott & Memphis.

SOUTHERN.—See Southern Railway in Mississippi.

SOUTHERN PACIFIC.—Gross earnings for the three months ended September 30, 1906, were $28,671,715, an increase of $3,008,936; net earnings, after taxes, $10,707,781, an increase of $1,942,542.

SOUTHERN RAILWAY IN MISSISSIPPI.—This is the operating company for the Southern Railway's line from the Alabama state line to Greenville, Miss., 179 miles including two branches. See Elections and Appointments column.

TOLEDO, ST. LOUIS & WESTERN.—Gross earnings for the year ended June 30, 1906, were $4,205,051, an increase of $419,887; net earnings $1,063,433, an increase of $257,978, the operating ratio having fallen from 78.7 to 74.7. The surplus after charges was $472,323, an increase of $299,712. The company has outstanding $10,000,000 common stock and $10,000,000 4 per cent. non-cumulative preferred stock on which dividends are not paid.

UNION PACIFIC.—Gross earnings of this company, including the Oregon Short Line and the Oregon Railroad & Navigation Company, for the three months ended September 30, 1906, were $18,913,650, an increase of $1,489,693; net earnings, after taxes, $9,206,111, an increase of $824,370.

UTAH LIGHT & RAILWAY COMPANY.—See Oregon Short Line.